AMERICAN MACHINIST

A PRACTICAL JOURNAL OF MACHINE CONSTRUCTION.

▲ ▲ ▲

VOLUME 21. NEW YORK, THURSDAY, JULY 21, 1898. NUMBER 29.

▲ ▲ ▲

Something About Traction Engines.

JOSEPH B. HALL.

While the production of traction engines is not as extensive as that of automatic stationary engines, still their manufacture is quite an important branch of the engineering business, more than forty concerns being engaged in it, with an annual output of about 8,000 engines, either traction or portable. My first acquaintance with these engines was at county fairs, where specimens appeared in all the glory of kaleidoscopic colors and gilt stripes; and until my direct and intimate contact with them I had the impression that they were built by cheap mechanics and designed by guess, with Providence as the factor of safety. It is reasonably safe to say that over 90 per cent. of the people not in the business or some of its branches believe the same. However, it did not take long to learn that bright men with good inventive ability were employed in their manufacture, as in the stationary engine business; and for the purpose intended, considering the conditions of use, traction engines are as perfect as either locomotives or stationary engines.

Traction engines are principally employed to operate threshing machines and haul them from farm to farm, to drag road scrapers and rollers; in one instance four traction engines are employed to haul wagon trains loaded with marble from a quarry to the railroad over a mountain road 7 miles long. The speed on the road is usually 3 to 3½ miles per hour, but many engineers throw off the governor belt and control by reverse motion or throttle, letting the speed become 6 or 7 miles an hour. At these speeds the piston travel is from 600 to 700 feet per minute, and as the usual stroke is 10 inches for all sizes from 10 to 25 horse-power, if the parts were not well balanced such engines would be soon racked to pieces.

Some of the things which an engine of this type has to contend with are faulty lubrication and bad feed water. I have seen oil cups filled with beef suet (raw tallow), and the engines expected to run cool. It is said (probably a joke) that apple butter has been used for the same purpose. Feed water varies in quality from the corrosive sulphur and copperas water (chalybeate), through hard limestone, scale forming water, to water highly impregnated with decayed vegetable matter, which latter causes dangerous foaming. The same engine may be furnished with these different kinds of water in as many different days. The season for threshing is usually from July to December, and varies according to climate, and skilled engineers at $3 a day are employed, as a rule, the engineers also acting as firemen. There is not much time given them for repairs, as the engineer must be close to the throttle in case of accident, and the only chance for repairs is on Sunday or between 6 P. M. and 6:30 A. M. on week days.

For such a (comparatively) costly piece of machinery the treatment given it in many cases after the threshing season is over is to be condemned, and such treatment is mainly what gives traction engines a poor name, for there is seldom provided a shed or even a tarpaulin. They are left in the open field at the mercy of rain, snow and frost, and a coating of red rust soon forms on the iron parts, making a new engine, used only one season, look as bad as one which has been run ten years. No other style of engine is required to do as hard work with such little care as they receive, and it is sometimes surprising that they so successfully fill all the requirements.

A traction engine usually consists of a boiler, with engine mounted on top of boiler, geared to rear (traction) wheels by means of spur or bevel gears or chains, the wheels usually having cleats to assist in the tractive power and mounted on springs. There are three types of boilers used, the first and most common being the locomotive type, then the Scotch marine type, less used, and the locomotive fire box with return flues, the latter now being rarely built. Straw-burning boilers are of the locomotive or marine type with larger grate surface or special modifications of the above, with baffle plates, combustion chambers, etc., each manufacturer claiming special advantages for his devices. Straw is almost the only fuel used in the Dakotas, Minnesota and Manitoba for firing traction engines.

The engine proper is usually a simple, throttle-governed side-crank engine with band fly-wheel, although several concerns

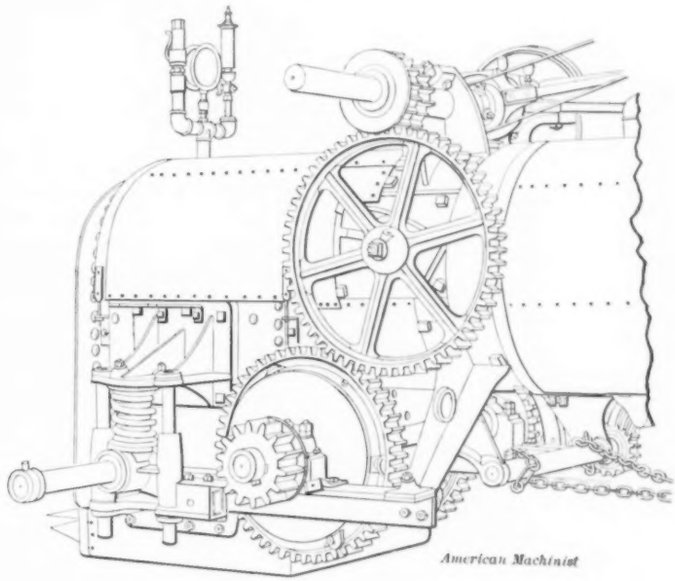


Fig. 1

GEARING OF TRACTION ENGINES.

are building center-crank engines. Plain D valves are the customary kind, although a few makes have piston or balanced valves. The governing is done by link or reverse motion, a throttling governor being used to limit the speed in case of sudden variations of load. A friction clutch (of which the fly-wheel is a part) is usually employed to transmit the power to the traction wheels. In the great wheat growing Northwest compound engines are to a great extent used, owing to the fact that water sometimes has to be hauled 5 miles or more to the engine, and the engines are rated higher in the following way; that is, the boiler capable of furnishing steam to a 20 horse-

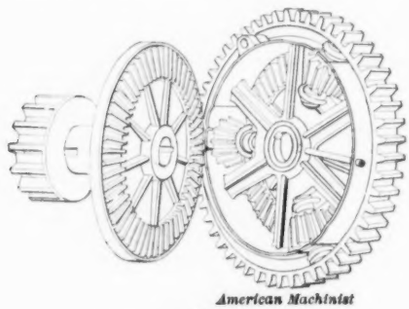


Fig. 2

JACK-IN-THE-BOX GEAR FOR TRACTION ENGINES.

power simple engine (nominal) is expected to furnish 25 horse-power with compound cylinders with ease. Table of manufacturers rating:

20	H.-P.	simple =	25	H.-P.	compound
15	"	"	20	"	"
12	"	"	15	"	"
9	"	"	12	"	"

Any traction engine will furnish at full power more than double its nominal horse-power. The Woolf type of tandem compound, with steam balance single valve, metal packing between cylinders and Woolf gear, is used in the majority of cases, other types being tandem cylinders with two valves and cross compound. For reversing, the "Stephenson link" and the type in which the eccentric slides across the shaft are most popular, followed by the "Woolf" and others, some of which are more or less troublesome, either from excessive wear of moving parts or from failing to keep the lead constant.

The tractive power is transmitted from the crank shaft to the rear drive wheels by spur gears, Fig. 1, in the majority of cases, by bevel gears in a lesser number owing to the existence of patents, and by chain and sprockets, very few being made of the latter. The traction wheels are driven independently by means of the jack-in-the-box gearing, Fig. 2, which enables the engine to turn readily without straining the gears or tearing up the ground. One of the methods of mounting on springs is shown in Fig. 1, together with the differential gear and the steering roller. The front wheels are seldom mounted on springs and are either pivoted under the center line of the boiler or have independent T axles turning on their own centers, the latter enabling the engines to be turned in a smaller space and preserving a more stable equilibrium. Either a cone spark arrester in the smoke stack or screens are used to stop sparks. Brakes are used on a great number, but are seemingly not needed, except to hold engines when they are not under steam. Injectors are mostly used for boiler feeding, though both injectors and crosshead pumps or injectors and independent pumps are frequently found in combination.

Owing to the forced draft required for the boiler considerable back pressure is maintained, sometimes as high as 35 pounds. So it may be seen that the efficiency must be low, ranging from a consumption of 30 to 36 pounds of water per horse-power hour in a simple cylinder, to 25 to 30 pounds per horse-power hour in a compound. Water heaters as used on some makes increase the efficiency slightly, but are often too small to do much good. The efficiency of the traction mechanism is to a great extent an unknown quantity, but is probably about 60 per cent. of the indicated horse-power of the engine.

▲ ▲ ▲

The Mundo Wheel Dividing Device.

BY MORRIS FULTON.

The three recent articles in the "American Machinist" by Mr. John Randol, describing three different ways in which dividing wheels have been actually originated, seem to open the way for a brief presentation of an entirely different device used at the Mundo Iron Works for the same purpose. As the rig was to be used for at least three different wheels, with three different numbers of teeth, it was thought worth while to do the work with some thoroughness and not to evade or neglect any particular which seemed necessary to secure the most accurate result possible. A peculiar and important feature of the apparatus, as will appear in the description, is that it may be used with equal facility, and with but one minute change of detail, for any number of equal divisions, it being, of course, undesirable to go to too high a number. I am not prepared to say that absolute accuracy was attained, for I have never yet seen a device proposed or employed for this purpose which was altogether satisfying.

In attempting a description of this interesting apparatus it will save time, probably, if we first get the adjective and adverb business out of the way, so that all along we will not have to be saying that this thing or the other was accurately or carefully done, and all that sort of thing. Good men did the work, they were interested in their work, they knew that they were expected to do their best, and they had unlimited time to do it in. If perfect workmanship was not secured all through it was because there is no perfect workmanship.

The drawing herewith is, I suppose, enough to show the principle and the mode of operating the apparatus. The drawing, of course, shows the dividing arrangement only and has nothing to do with the actual cutting of the teeth, as about that operation there was nothing particularly deserving of remark. The gear to be cut was mounted upon the central spindle, which extended up to a sufficient hight for the purpose. Two heavy uprights rose from the two front corners of the base—the bottom of the drawing as it appears—and these carried a crosspiece with slides and all the necessary arrangements for driving and vertically feeding the cutter. Great care was of course given to the shouldering of the cutter arbor, as upon that, after all, the accuracy of the machine depended as much as upon the actual dividing mechanism. The cutting apparatus was as independent as possible of the dividing apparatus, although held in rigid relation to it. The heating in the operation of cutting was avoided as much as possible by using a sharp cutter and running slowly, slowness of cutter movement being considered more important than fineness of feed. The chips also were carefully caught so that they did not interfere in any way with the lower apparatus.

The drawing shows the apparatus as used for cutting a wheel of forty-eight teeth, the number for which it was first employed. The diameter of the outer circle is 6 feet, so that it will be seen that it was quite heavy and costly for material alone, and for the preliminary machine work. The four main pieces were of cast iron and were good, sound castings.

The base *A* was a solid ring 5 inches thick vertically and 6 inches horizontally, connected by a thick web and heavy ribs to the central hub. A masonry foundation was provided for the three bearing points, at the two front corners and the center of the back. The three feet were planed on the bottom, and the other machine work upon this piece was the facing of the top of the ring and of the hub to the same plane, the boring of the hub, and also the facing of the under side of it. The upright *E* at the back was fitted snug between two vertical ears and against a faced surface, and held by the two 1½ inch studs shown. Upon the base *A* was the six armed wheel *B*, of the same external diameter, and the rim and hub, both 4 inches thick. The central 4 inch steel spindle was fastened in the wheel hub, while it was free to turn in the base, and projected through the base-hub long enough for a collar with a cross-pin, although this collar seemed to be quite unnecessary. The wheel therefore could be moved around freely, and had

no fastening except the straight pin *F* through the upright *E* at the back, which pin was used for the first locating of the wheel when the operation of dividing was begun. Centrally in the upper side of this gear ring was a T slot, turned all over, for 1 inch bolts. The bolts used had square heads and several square holes in the under side were provided for slipping the bolts in.

Above the gear *B* were the two other pieces, *C* and *D*, each comprising a portion of a third ring with arms connecting to hubs on the central spindle. The radii, internal and external, of these ring segments were the same as that of the gear ring *B*, while the vertical thickness was 4½ inches. The hub for each segment was only one-half this thickness, that of *C* being below and that of *D* above. The arms for each segment were a little thinner than the hubs, so that when the ring segments were turned around in either direction their ends could touch each other without the interference of the arms. While these segments were so fitted as to move freely around upon the wheel, provision was made for clamping them securely to it. Two T bolts passed up through suitable holes in *C* with a heavy crossbar above and a central screw, with a hand wheel proportionately considerably larger than shown in the sketch. The nuts on the T bolts were first adjusted to hold the bar near the casting, and then the tightening of the central screw clamped *C* securely to the wheel *B*. Two of these clamping devices were provided on *D*, as shown.

The length of the segment *C* was precisely one-sixth of a circle, so that it could properly be called a sextant, while *D* was considerably more than a quarter of the circle. The precise relative angle for each portion was of no importance, while the sum of the two was of the greatest importance, as the operation of the apparatus depended entirely upon that. Accordingly at one end of *D* was provided an arrangement for minutely adjusting the length. The end of *D* was tapped 2 inches diameter and 25 threads to the inch, and into this was screwed the screw with the large head and a spherical face of large radius on the outside. Inside this fine threaded hole was a large vertical mortise through the casting. The screw had an enlongation on the inner end 1 inch diameter with a round nut on the end. When the screw was in place a washer was placed over the hole of the large screw, then over this was placed a stiff push spring, another washer and then the round nut, which was tightened by a pin inserted in the side holes. The function of this spring was merely to take up the slack in the large, fine screw *H* and keep it always to a snug bearing backward against the threads.

Probably enough has been said in explanation of the construction to enable us now to understand the operation of the apparatus. Both *C* and *D* are assumed to be clamped securely to the wheel *B*, and the pins *F* and *G* to be in place.

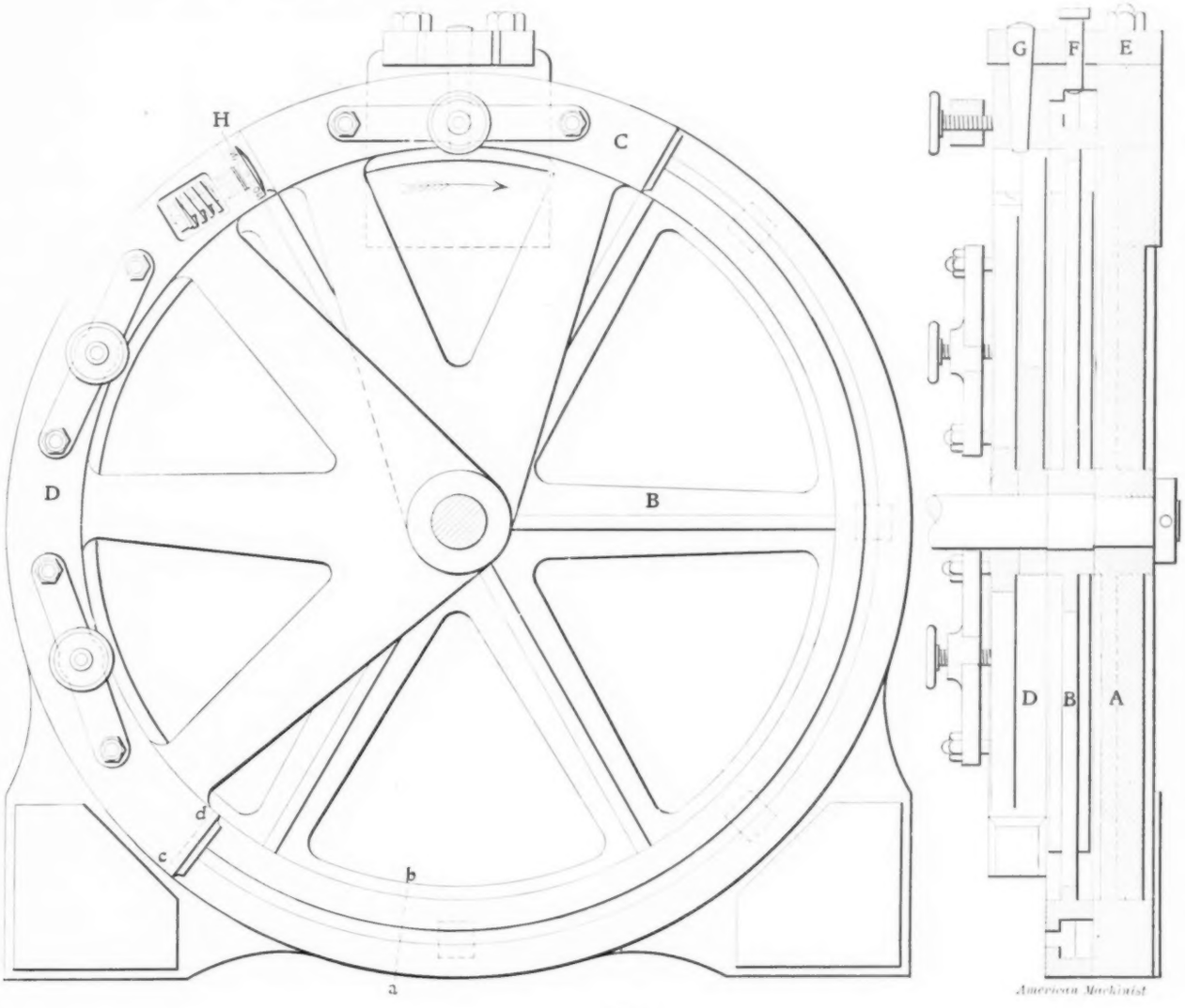


Fig. 1

THE MUNDO WHEEL DIVIDING DEVICE.

Everything would now be in readiness for cutting the first tooth of the forty-eighth tooth gear if we were assured that the adjustment for accurate spacing were correct, which it most certainly is not.

The pin *F* is first removed and will not be wanted again until the wheel has been placed successively in the forty-seven positions for the other teeth, and then the forty-eighth position after the first will, of course, be the same as the first, and if the spacing has been correctly done the pin will pass readily into its place when the gear has been placed in this forty-eighth position.

The taper pin *G* is now removed; *C* is unclamped and moved around in the direction of the arrow until it touches *D* at the other end. This brings the center line of *C* to the line *a b*, it having traversed not 180°, but 187½°, or the space of twenty-five teeth instead of twenty-four teeth. *C* is now clamped securely in contact with *D*, and the wheel *B* with both *C* and *D* fastened to it is turned around until the taper pin *G* is again inserted.

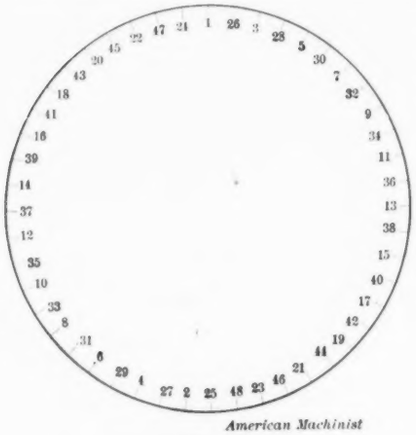


Fig. 2

THE SUCCESSION OF MOVEMENTS.

This pin must be put in securely and must hold *C* in position until *D* is slackened, moved around to the other side of *C* and then fastened again. This alternate chasing of *C* and *D* is carried on until the successive forty-eight positions have been assumed, when the first position of the next series should be the same as the first, and the pin *F* should slide into place. Every time *C* is brought into position for the insertion of the taper pin *G* the spindle is then in position for the cutting of another tooth. The successive teeth as cut will thus be twenty-three teeth apart, the order in which the teeth are cut being shown in Fig. 2.

The preliminary adjustment of the screw *H* is a matter of great delicacy, and a number of traversings of the series of positions is required before the correct result is reached. After the nearest possible adjustment of the screw has been secured, with a little excess in the resulting movement, the final result is accomplished by oil-stoning the spherical face of the screw or by scraping the face of *C*, with which it comes in contact. A spherical cavity, at least 1 inch in diameter, should be scraped in the face of *C* before beginning the adjustment, to give a sufficient contact surface. The other two surfaces which touch should also be scraped to a good bearing. Care must be exercised in making the contacts. The segments must be made to approach each other slowly, and the actual pressure of contact should be secured by pushing with a spring against the free end until a certain measured tension is secured, and maintaining that tension until the segment is clamped.

If some other number of teeth were required instead of forty-eight, the difference in the total angle of *C* and *D* would only be the difference in the circumferential pitch of a single tooth. Thus, with forty-eight teeth the angle per tooth is 7½°, while with seventy-two teeth the angle per tooth is 5°, so that the required difference would be 2½°, or about what is indicated by the dotted line *c d*, Fig. 1, only this thickness would be required to be added, instead of being taken off, and this might be done by accurately fitting a plate covering the whole end surface and fastening with countersink screws. After the fitting of the plate the same trial adjustment all through the series would of course have to be gone through with as before.

It is not necessary to call attention to the care and patience required in spacing by this device. Both changes of temperature and the presence of dust or dirt at the contact surfaces are to be avoided, and also sudden knocks or anything but uniform contact pressures. The difficulty of finally adjusting the contact surface with sufficient minuteness cannot certainly be more difficult with a single surface than with a separate piece for each tooth, as in other devices described. The cutting of alternate teeth upon opposite sides of the gear gives better opportunity for cooling between the cuts and less distortion than when successive teeth are cut near together. Until half the teeth are cut by this system no tooth is cut next to one already cut, and for the other half each cutting is with a previous cut alike upon each side of it. Altogether the device seems to be deserving of serious and respectful consideration.

▲ ▲ ▲

Gear Teeth in the Metric System.

We have received from Mr. E. R. Fellows, of the Fellows Gear Shaper Company, a blue-print table of diametral pitch metric system gear teeth as practiced by the famous French house of Ducommun & Cie., of Mulhouse, which agrees almost exactly with the table supplied by Mr. Lobben and published in our issue of June 30. The Ducommun formula for the total depth of the tooth is

$$H = 2\,\tfrac{1}{6}\,M$$

H being the depth and *M* the "module" or metric pitch number. Mr. Lobben's formula used the constant 2.15708 in place of 2 1-6. Apart from this and the fact that the Ducommun table is carried to an additional decimal place there are no discrepancies.

We note, however, an error in Mr. Lobben's table in the value for *t* belonging with 1¾ for *m*. This was given as 2.01, but calculation from the formula will show that it should have been 2.75.

▲ ▲ ▲

Multi-Spindle Boring and Tapping Machine.

We illustrate herewith a very complete development of the turret idea, intended for the manufacture upon a large scale of various articles of brass having some complication in the form of individual parts, such, for instance, as injector bodies, which latter it will finish complete from the rough casting.

The machine may be described as a double turret machine, one turret carrying the tools while the other carries the work, the second turret being so arranged that the different portions of the casting on which work is to be done may be presented to the tools in succession, while the number of tools is increased to twelve, permitting a corresponding variety of operations to be done.

Our characterization of this machine as a double turret machine must be taken in its broad meaning. The machine does not in fact contain what would ordinarily be called a turret, but nevertheless the turret idea of the presentation of a succession of tools to the work, with the necessary limiting stops, is the leading feature of the machine.

The turret or work supporting face plate to which the casting to be operated upon is bolted will be seen at the left in Fig. 1 and at the right in Fig. 2. In the use of the machine this face plate has bolted to it a special chuck designed to receive and locate the piece to be operated upon. The face plate is mounted on an elevating knee, on which it has both lengthwise and crosswise motion, the shafts for accomplishing these motions being seen in Fig. 1. The shaft having its crank in place just at the left of the cabinet base adjusts the table lengthwise of the knee; the shaft at the left of this, with its crank removed, elevates the knee, while the crosswise motion is by the upper crank. These movements of the table are not, however, for the purpose of the feed, but for adjustment—the feeding movement being made by the cutter spindles. The face plate revolves to present the different parts of the work to the tools, the crooked lever at the left of the cross-feed shaft serving to operate the locking pin and to bind the plate in position with a single movement.

The various tools are mounted in the horizontal taper socketed spindles seen

projecting through the circular head on top of the cabinet base. This head contains a hollow revolving carrier in which the spindles are mounted, carrier and spindles revolving together to present the tools in succession. Above the circular head will be seen a small belt pulley, and the release and clutch mechanism by which this revolution is effected—this pulley being belted from a similar one seen in Fig. 2 on the shaft carrying the main cones. It will be seen that there

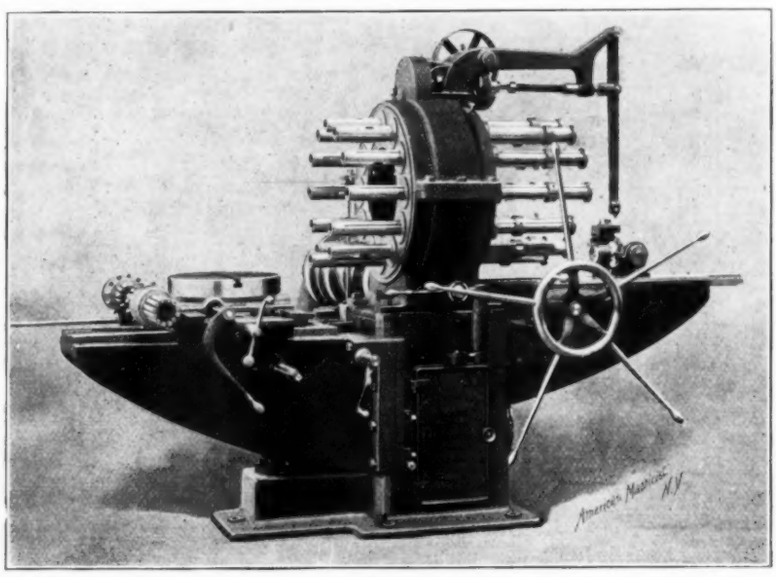


FIG. 1.—FRONT SIDE.

are two of these main cones, one being speeded for boring while the other is used for tapping. The lever for throwing the machine on either of these cones, or off of both, will be seen to the left and behind the pilot wheel of Fig. 1, which represents the operator's side of the machine.

The horizontal feed of the spindles is accomplished by the pilot wheel—hand feeding to the work being considered better for this class of work, and probably quicker as well, owing to the cuts being short and the amount of waste travel of the tools considerable in some of the cuts. The pilot wheel actuates directly a slide, seen in Fig. 1 projecting from the right-hand knee. On this slide is placed a bracket carrying a short cup-ended spindle which engages the end of the work spindle and drives it forward—the thrust being taken by a ball-bearing on the bracket. The end motion of the tool spindles toward the work is limited by adjustable stop collars, one of which will be seen on each spindle. The bracket described also has an ice tong device which hooks over the heads of the spindles and withdraws them. At the completion of the withdrawal the ice tongs open and release the spindle, when further movement of the pilot wheel actuates the lever seen hanging from the overhead bracket, thereby releasing the revolving head and engaging the turning gear, when the entire head with the twelve tool spindles revolves and brings the next spindle in position. As this goes on, the spindle which has just been in use stops its own motion and the one which follows it begins to revolve as it takes its place ready for work.

In front of the work table will be seen a pair of cylindrical birdcage affairs, which are in fact a series of stops for the crosswise movement of the table. These

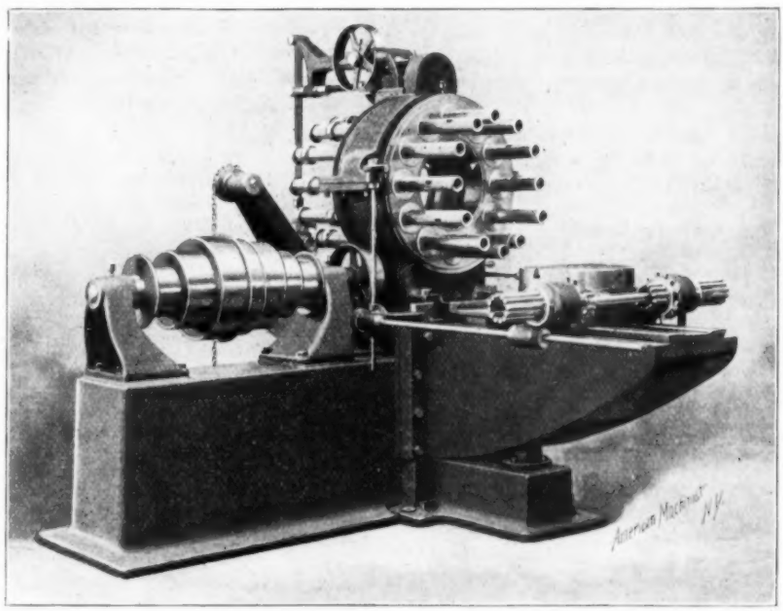


FIG. 2.—REAR SIDE MULTI-SPINDLE BORING AND TAPPING MACHINE.

enable the table to be located either centrally with the tool spindles or offset if necessary, while the double set of stops enables two settings to be made for each position of the work table, such as, for example, would be needed for the overflow and feed connections as usually placed on injectors. These connections are usually parallel with one another, and would be made with the work table in the same position so far as its revolution is concerned, but to reach the two positions the table must be adjusted across the knee support, and these stops define this movement and properly locate the cuts. The number of stops will be seen to agree with the number of tool spindles, and a train of shafts and spiral gears will be seen to connect the stops with the revolving spindle carrier, so that the revolution of this carrier rotates the entire set of stops and insures that the stop belonging to each spindle shall be presented to the stationary stop when that spindle is in position for work.

It will be seen that in use the casting to be operated on is instantly located by the jig chuck on the work table, and that the various bosses and other parts to be machined can be brought in position for work and the tools can be presented to them with the celerity of a common turret lathe job, while the stops on the tool spindles and work table define the depth and positions of the various cuts with the same certainty as in the more usual styles of turret lathes. The vertical adjustment of the knee and the adjustments of the work table on the knee provide for a wide range of work.

The machine will be seen:

1. To be a highly organized machine for the performance of a defined class of operations.

2. To be an embodiment of the idea of definite mechanical methods intended to obviate measurements by hand in the production of a large number of pieces of the same kind and so secure interchangeability.

3. To represent the investment of con-

siderable capital in order to expedite work and save labor.

These items fairly describe what we call the American method of manufacture, and as an embodiment of this method we think it will be agreed that the machine stands well in the foreground. It is a larger machine than would be inferred from the pictures, the length over all, measured from end to end of the knees, being about 10 feet.

The machine is the product of the Bullard Machine Tool Company, of Bridgeport, Conn.

▲ ▲ ▲

Tools for Lathe Testing.

BY OSCAR E. PERRIGO.

At this time, when such extreme accuracy in machine tools is demanded, when it may be said that the machine tool that could be sold as a fairly good tool ten or even five years ago could scarcely be given away now; when a buyer critically tests every requirement of the machine he buys and ofttimes almost literally dissects it, it becomes necessary to adopt such methods and to provide such appliances as will insure a practical demonstration of its accuracy. Although the lathe is the oldest known machine tool we have, we are far from knowing all its capabilities and possibilities as yet, and each year finds some added good points brought out by the many workers in the field.

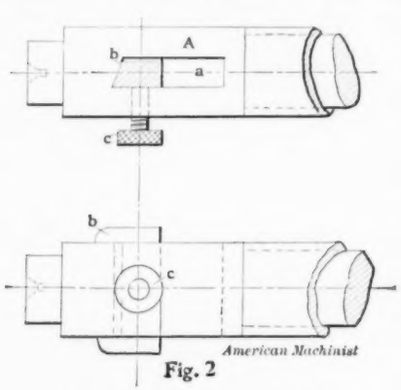


Fig. 2

DETAIL OF TESTING BAR

But whatever may be its special form or construction it becomes a matter of vital importance to practically test it before it leaves the hands of the manufacturer. The following account is submitted of a comparatively simple and not necessarily expensive apparatus for this purpose.

This matter was very ably treated in an article by Mr. T. H. Miller in the issue of March 3, but in this case, from the standpoint of the buyer or user of the lathe, who would find it impracticable to construct apparatus, and therefore must improvise something for the purpose, my intention is to describe apparatus suitable for the manufacturer of the lathe who would make these tests, or others equally reliable, before the lathe leaves the manufactory.

Fig. 1 shows the general construction of the testing device, as applied to a lathe, for ascertaining the alignment of the head and tail spindles. An arbor, *A*, is preferably constructed of thick steel tubing with hardened steel plugs fitted to and forced into the ends, which have been previously bored out. This arbor is ground true and should be from 4 to 6 inches longer than the diameter of the largest face plate to be tested. Upon the arbor is accurately fitted a hardened and ground collar, *B*. At the end of the arbor next to the face plate the plug has a mortise, *a*, made square at one end and at an angle at the other, as shown in Fig. 2. At the angled end is fitted a key, *b*, with the usual projections, to prevent it from dropping out, and controlled by the thumbscrew *c*. Passing through the mortise *a* is a bar, *C*, carrying at its outer end a micrometer screw device, represented in detail in Figs. 3 and 4. This consists of a bar, *D*, of a size convenient to hold in the tool post of the lathe as well as in the slotted end of the bar *C*, where it is clamped by the thumbscrew *k*. Pivoted to the bar *D* is the curved bar *E*, having pivoted to it the block *F*, which carries the micrometer screw *G*, operated in the usual manner. The knurled thumbscrews *d e* fix these joints in any desired position.

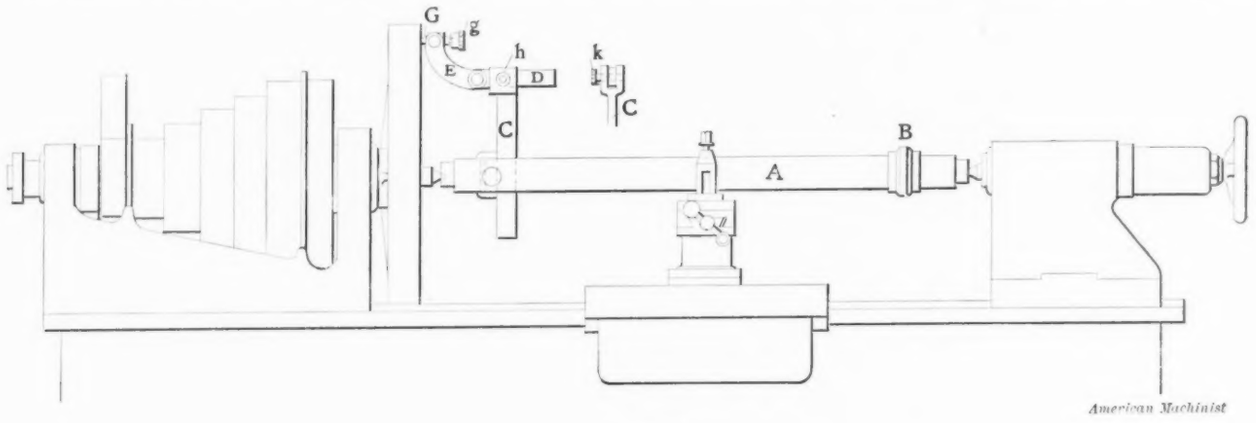


Fig. 1

TESTING ALIGNMENT OF LATHE SPINDLES.

The use of this apparatus is as follows: Place the arbor in the lathe, slide the collar *B* up near the mortise *a*, clamp the micrometer device in the tool post in the position shown in Fig. 5, and bring the point of the micrometer screw down upon the collar *B*, rotating the latter slightly to get the pressure just right. Slide the collar *B* to near the footstock, move the carriage down opposite to it and note if the micrometer screw rests upon the collar as before. If not, note on the graduations of the micrometer the amount that the tail spindle is high or low.

It is assumed that the centers have previously lined fairly well sidewise. To set them accurately the same method as above is used, setting the micrometer device as shown in Fig. 6.

Supposing that the centers of the lathe have been found to line vertically and horizontally correct, we now desire to know if the back box of the head spindle is set in exact prolongation of the line of centers. Place the bar *C* in position and clamp the micrometer device in it, as shown in

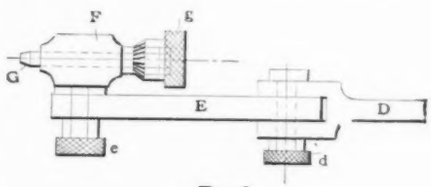


Fig. 3

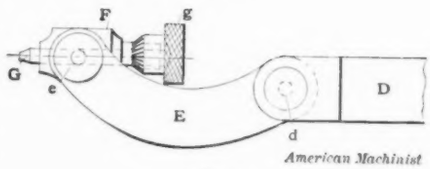


Fig. 4

MICROMETER IN POSITION FOR TEST.

Fig. 1. Slowly revolve the tram device thus arranged, setting the micrometer screw to the nearest point in contact with the face plate. Continue the revolution and with the micrometer screw ascertain the exact variations of the face plate from a perfect right angle with the line of centers. Having determined the accuracy of alignment of the lathe we now

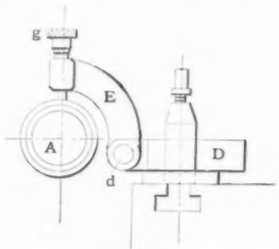
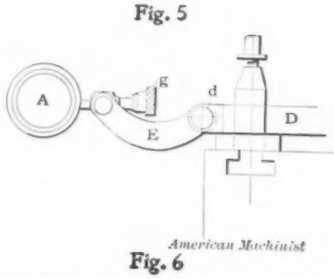


Fig. 5



American Machinist

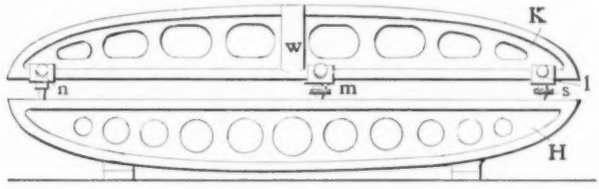
Fig. 6

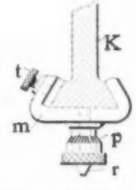
TESTING ALIGNMENT OF TAIL SPINDLE.

desire to test its accuracy of facing—whether it will face up or piece concave, convex or exactly true, and to note the extent of the variation.

Figs. 7 and 8 show an adjustable straightedge for this purpose. *H* is a permanent straightedge used only for adjusting the one applied to the face plate. This is shown at *K* and has its lower edge formed as shown in Fig. 8, and has three blocks, *l*, *m* and *n*, sliding upon it and fixed at any point by the thumbscrew *t*. These blocks are set at such distances apart as will accommodate the size of the face plate to be tested. The block *n* carries a fixed point, about 3-16 of an inch in diameter at the point. The block *l* carries a plain screw point, *s*, used to adjust the device so that the micrometer screw *r* of the block *m* may be adjusted at zero. To adjust these set the micrometer screw at zero and then bring the screw *s* up or down till all these points rest properly on the permanent straightedge. To apply the device to the face plate to be tested the surface *w* is placed downward on a short arbor, taking the place of the head center of the lathe and projecting about 6 inches from the face plate. This not only furnishes a convenient support, but keeps the contact points at right angles to the face plate. Keeping the points of the block *n* and the adjusting screw *s* in contact with the face plate, the micrometer screw *r* may be set to the convexity or concavity of the plate and the error read on the micrometer graduations, *p*, in thousands of an inch, or even much finer.

In Mr. Miller's article, above referred to, he gives a test for square facing which requires no special device, and the same test may obviously be made by the micrometer device here shown, held in the tool post and applied to the face plate at different points or to a single point first turned to the front and then to the rear. But such a test, while it shows whether the cross-slide is at right angles to the spindle or not, and how much it is out, if at all, does not show whether the cross-slide is straight or not. That is to say, it might sometimes happen that two points equidistant from the center would lie in a line at right angles to the center line of spindle, but between these points the cross-slide might be out of square.





American Machinist

Fig. 7

Fig. 8

STRAIGHT-EDGE FOR TESTING CROSS SLIDE.

▲ ▲ ▲

Aluminum Conductors for Electricity at Niagara Falls.

In our issue of June 23 reference was made to the supply of electric current by the Niagara Falls Hydraulic Power and Manufacturing Company to the works of the National Electrolytic Company. An additional feature of this installation is the use of aluminum conductors for the current. The power house is situated at the water's edge in the gorge, while the National Electrolytic Company's plant stands on the high bank, some 200 feet above. These aluminum conductors have been placed and the generator is now in operation. The generator is the largest of its kind ever made in this country and the conductors are the first of the kind put into service. From the switchboard in the power house to the top of the high bank the conductors are in the form of bars, each 25 feet long, half an inch thick and 6 inches wide, four being placed in parallel. They are bolted and riveted together every 25 feet and in passing to the top of the cliff they extend along the side of the penstock on brackets. On reaching the top of the cliff the bars are connected to aluminum cables, twelve being used on each side. The diameter of the cables is 1¼ inches, covered with rubber insulation. No. 10 wire is used in their construction. The ends of the cables and bars are placed in sockets and melted tin is poured about them, thus forming a solid and a permanent joint. In all about 22,000 pounds of aluminum is used in making the conductors, and it is 99½ per cent. pure. The determined conductivity of aluminum in the same section as compared with copper is 63 to 64 per cent., the weight being about 48 per cent. It was found that, owing to their lighter weight, the task of erecting the aluminum conductors was not so great as it would have been had they been made of copper.

▲ ▲ ▲

The Manufacture of Steel Castings.*

BY STEWART JOHNSTON.

The modern crucible steel furnace is constructed in a rectangular well shape, the top of which is usually at floor level. At either side of the hole, or furnace proper, are two chambers filled with open brick work called checkers. Gas, generally used as fuel, is brought through one of these chambers and air through the other, the two uniting at and around the crucibles where the combustion takes place, the waste heat and products of combustion passing out and heating checkers in the two chambers on the other side. At stated intervals the direction of the exit and entrance of the air and gas is reversed. This method, as described, of bringing heated air to support the combustion of the heated gas, is known as Siemen's regenerative process. The top of the hole or furnace proper is made in a number of sections, which are removed to admit of putting in or taking out the crucible. The charge consists of about 100 pounds wrought iron or steel clippings, with proper additions of manganese, silicon or other ingredients, to insure solidity to the castings. The crucibles, after being filled, are covered with a lid of the same material as the pot, and the "puller out," as is called the furnace helper, by the aid of tongs, lowers them into the furnace. After from three to four hours the mixture is brought to the proper condition, and the "puller out" lifts the pots from the furnace, from whence they are carried to the molds and poured. Furnaces are built to hold from eighteen to thirty-six pots.

The Bessemer or pneumatic process consists of placing molten iron in a converter, an elipsoidal retort, and forcing air through the metal until the iron is decarbonized, as well as reduced in man-

*Condensed from a paper presented at the Cincinnati meeting (June, 1898) of the American Foundrymen's Association.

ganese and silicon. In nearly a horizontal position the converter receives the iron from the cupola, the blast is then turned on and enters through one end of the converter, which is then revolved 90 degrees into a nearly vertical position, the molten iron covering the tuyeres through which the blast is being forced. By the action of this blast through the molten metal a high temperature is developed by the combustion and oxidation of carbon, manganese and silicon; the heat thus developed being sufficient to maintain the charge in a state of fluidity. In fact, the temperature increases during the process until nearing the end. The iron, having been decarbonized, or converted into steel, then has added the spiegel and is ready for the ladle, from whence it goes to the molds. The Bessemer process is to-day substantially as first introduced, and unlike it, few inventions are at their inception so nearly perfect as to admit of but little or any improvement. A great number of patents on the method, or place, of introducing the blast have been taken out, and these various methods, or processes, usually bear the patentee's name, but they are but variations of the original idea of Bessemer, to whom due credit must be given.

The open-hearth process is but a development of older forms. More particularly it may be said that the furnace is usually rectangular in shape, the center and upper portion of which is the hearth proper, which is supported on a structural bed, and beneath it are two pairs of regenerators. The gas under pressure and air are introduced through one set of regenerators, passing up through same, enter the hearth at one end, combustion taking place over the metal charge, the waste products of combustion passing through the other pair of regenerators, the exit of gas and air being reversed at regular intervals. On one side of the furnace are doors through which a charge of pig iron, steel or other scrap and ore is thrown in to be melted, and on the other side is the tap hole. It will be noticed this process differs from the other two described, in that the flame comes in direct contact with the metal charge.

To Geo. Cowing, of Cleveland, Ohio, is attributed the distinction of first making a mold for steel, much the same as is to-day used, of nearly pure silica, which material is first ground and mixed, and brought to the proper temper and adhesion by addition of glue water, molasses water, or flour water, and when made into a mold is generally faced with silica dust or quartz ground to an impalpable powder.

After having obtained the right sand mixture, precaution must be taken in ramming well the mold, for steel is so much more trying on it than iron that if this be lost sight of in the molding, scabbing can be expected, and can only be prevented by hard pounding of every part of the mold.

The contraction of steel being nearly, and in some shapes quite, double that of iron, care also must be exercised in preparing molds that this excessive shrinkage is not interfered with, otherwise the much dreaded shrinkage crack or "pull" will develop, but cracks and checks must not always be laid to the molding, as in many cases it is due solely to the treatment the steel has received in process of decarbonization.

After successfully making the mold it is taken to the oven and well dried; failure to thoroughly dessicate it is a frequent cause of pit holes, rough and scabby surfaces, while when rightly made and cared for it will produce a casting that cleans with comparative ease, leaving a fine blue surface. Quite a number of light, intricate shapes are now cast in green sand; it being less rigid enables pieces to be made that would check in cooling if made in a dried mold. Molds skin dried with benzine flash, or otherwise, are also common practice for such lighter shapes.

After casting, when care is taken to loosen the sand to admit of contraction and the piece allowed to cool in the sand, the rule is now general to omit the annealing, which some years ago was thought essential. More particularly to heavy sections it is a question whether annealing as often practiced is not detrimental. The Government still require all castings for it to be annealed, which operation the inspector may at any time witness. The Ordnance Department of the Government specifies the following physical characteristics must be obtained, if possible, in the No. 1 steel castings that are employed in the construction of gun carriages:

Ultimate tensile strength, 70,000 pounds per square inch.

Reduction of area at point of fracture, 36 per cent.

Elongation in 2 inches, 25 per cent.

A minimum toleration is:

Ultimate tensile strength, 60,000 pounds per square inch.

Reduction of area at point of fracture, 30 per cent.

Elongation in 2 inches, 18 per cent.

The uses to which steel castings are put are beyond enumeration and are daily becoming more varied, although at the time of their introduction in this country in the seventies their position in the commercial world was one of insignificance. Limited to a few lines, the production in first years did not annually exceed 200 tons. Steel castings now invade every field in metallurgy, save the one occupied by the chilled iron roll when used for rolling finished steel, and for that purpose no steel cast substitute has ever been considered a dangerous rival.

It is estimated that the annual production of steel castings is from 80,000 to 100,000 tons in the United States. The reports of production of steel castings as furnished to the American Iron & Steel Association, by those plants making ingots for rolling also, do not separate the tonnage of ingots and castings, hence it is to be regretted that the Association cannot give statistics of castings exclusively.

In 1872 castings of plain sections, weighing 100 pounds, sold as high as 20 to 25 cents per pound, and not many years back the price for Government work was 18 cents per pound for large plain sections, but, as the demand increased so came the capacity for supply, the latter always considerably and of late years much in excess of the former, with the natural consequence that the average price of castings is down to about 3 cents per pound, while favorable shapes have been sold as low as 2½ cents per pound.

The all-absorbing topic in these war times is the make-up of our navy, and it may be worth calling attention to the important factor steel castings play in the game of "hide and seek" enacted in the Caribbean Sea. A warship has the following principal parts made of steel castings:

Stem, stern posts, shaft hangers, stern tubes, bow and stern chocks, riding, towing and mooring bits, anchor masts, anchor crane bearings, outboard bearings, thrust blocks, large engine bed plates, engine housings, steam chest connections, pistons, etc.

These parts on a first-class battleship weigh about 500 tons, bearing in mind that this is exclusive of the gun mounts, and includes only parts of the engine and ship proper. The steel castings in a barbette carriage for a 12-inch gun weigh about 65,000 pounds.

▲ ▲ ▲

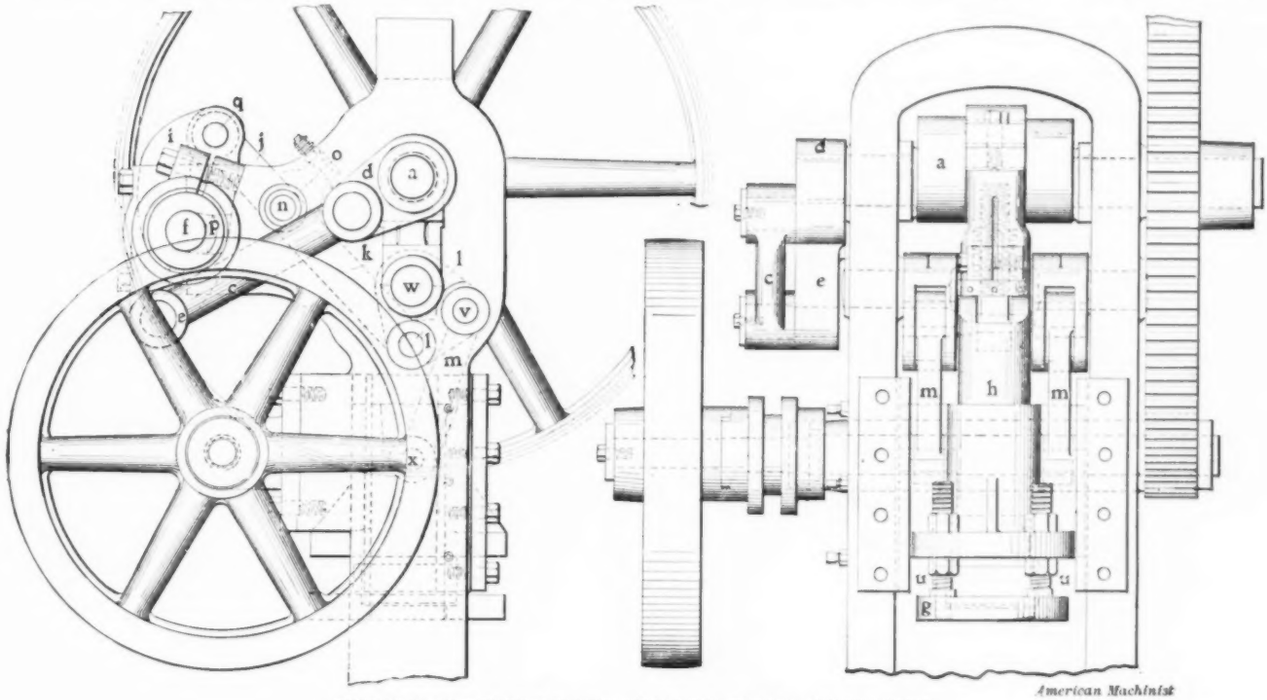
Drawing Press With Improved Toggle Movement.

In the drawing press shown in the accompanying illustrations a noticeable feature is in the "dwell" mechanism provided for the blank holder. The absolute and prolonged rest of the blank holder secured enables the drawing of very thin material without depending upon the opening of the press or any of its parts, as the metal will firmly hold to the blank without causing any unnecessary strain on the same. The dwell of the blank holder occupies 135 degrees, or three-eighths, of the stroke, thus, when wo k is drawn right through the die, giving especial advantage for deep work.

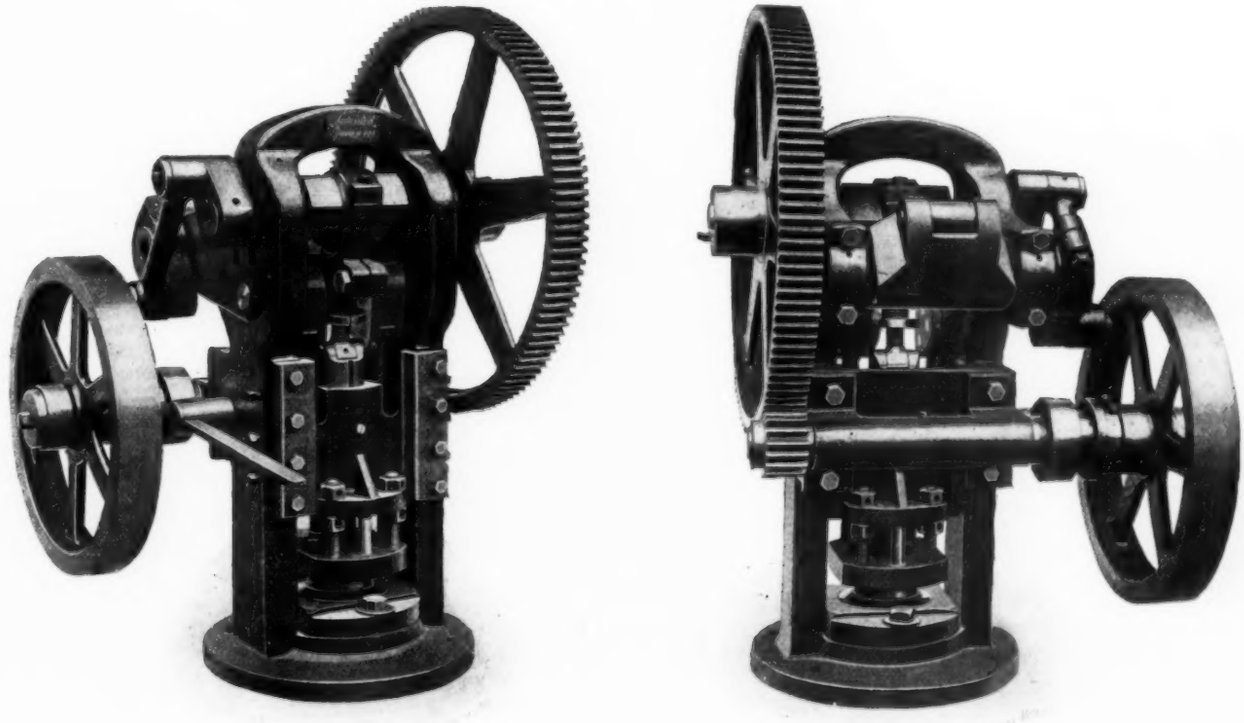
The half-tones, Figs. 1 and 2, show both the front and the back of the press. The large sliding piece carries the blank holder with the four adjusting screws for the hight and pressure. This slide is operated by the two side connections and the system of levers to be described. The central punch or plunger is operated di-

rectly by the central crank on the main gear shaft, the connecting rod being provided with a large screw adjustment for length.

Referring to Fig. 3, the movement of inside the frame, are two similar cranks *i* with connecting rods *j k*, these rods attached to pins *t*, on cranks *l*, and then by pins *v* on the same cranks and the links *m*, giving the required vertical movement posed of the two parts *j k* and jointed at *n*, do not remain straight and rigid. The joint at *n* permits flexure, while the projecting lugs at *o* limit this flexure to one direction only. In the position of the



DETAILS OF TOGGLE PRESS SHOWING DWELL MECHANISM.



IMPROVED TOGGLE PRESS.

the blank holder may be understood. The crank *d* on the outer end of the main shaft connects by the rod *c* with the crank *e* on the end of rocker *f*, giving it a large angle of movement. On the rocker *f*, to the blank holder. If the connecting rods *j k* were single straight rods the movement of the blank holder would always be coincident with that of the rocker shaft *f*. These rods, however, each com- parts as shown in Fig. 3 the blank holder is at the limit of its upward movement, and as crank *d* continues to turn the blank holder descends. While this descending movement is in progress the

cranks *i* swing to the left, and the connecting rods *j k* swing nearer to the center of the rocker *f*. At the joint *n* there are pins projecting at the side, and these pins drop into the central pockets *f* of the rocker before its rocking movement is completed. When the pin *n* is in the pocket *f* the rod *k* can of course swing no further and is stopped there, and as long as it stops there the blank holder is held down. The part *j*, however, swings with the rocker, the center of the pin *n* being coincident with the center of the rocker, and the lugs on the connections separate at *o*. On the return movement of the rocker the connecting rod *j k* resumes its regular function as soon as the rod becomes straight by the return of *j*. The bolts and springs at the ends of the lugs always insure the straightening of the rod. The movement of the blank holder and its stoppage are of course arranged to occur at the right times in relation to the central plunger. When the blank holder is in its lowest position, the pins *v*, connecting cranks *l* and links *m* are in a straight line with the fulcrum *w* and the pins *x*, thereby relieving all the other parts of strain. The press is manufactured by the Waterbury-Farrell Foundry & Machine Company, Waterbury, Conn.

▲ ▲ ▲

Letters from Practical Men.

Wide Feeds and Tools—Multiple vs. Single Tools—Cutting Speeds and Feeds.

Editor American Machinist:

Regarding the 12¼ inch finishing chip illustrated in your issue of the 16th I feel that I ought to come in for a share of the honors with my friend, Mr. J. H. B. Bryan. In my travels last year I carried with me a finishing chip same as the one shown, but only 6 inches wide, and among others to whom I showed it was Mr. B. I also made him as well as others who were interested a sketch of the tool with which it was produced, the tool sketched being substantially as described by you.

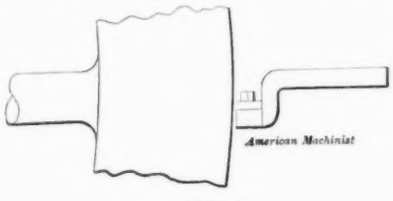


Fig. 1

A BROAD FEED FINISHING TOOL.

While superintendent of the Hercules Iron Works, at Aurora, Ill., in 1892-93, where the ice machines which were burned in the World's Fair cold storage plant were built, I had a tool of 12-inch face made to take the scraping cut on the rim of the fly-wheels for those ice machines. See Fig. 1. This tool was made with a machine steel shank about 3½ by 1½ inches, 14 inches long. The cutting end dropped down as shown, same as any spring tool and in the form of a T. On top of this T a blade of 2 by ¾ steel, 12 inches long, was secured by four ⅝-inch cap screws. The tool I used in producing the 6-inch chip on the planer is now at the Miehle Printing Press Company's works, Chicago, and is made like Fig. 2. The blade is made to be secured by fillister head screws on to the shank, and is removable for grinding, which must be done on a surface grinding machine. All that is necessary in taking wide cuts, whether 12 inches or 12 miles, is to have the work, the tool, the machine and the man with the nerve and judgment to do it.

While on this subject I want to refer to another article in the same issue by Mr. John Richards, who says: "Not only the unskilled, but often the office, people around a machine works wonder and say: 'Why not use a number of tools and cut the iron away at once?'" Then Mr. Richards goes on to say that "the answer to this problem is not always ready, is not written in books, is hard to put into words, but is well known to the practical man." The answer to this question of "Why not?" is difficult to answer, because in my opinion there is no reason. Why not? Sixty tools cutting one minute under proper conditions will do the work of one tool cutting sixty minutes. I have seen a roughing cut taken through a 9-inch cylinder 17 inches long in twelve minutes, fourteen cutters being in action together. As to "heroic treatment of metal by the cold process" being a "dream of the uninitiated," do we not see every day 8 inch square steel blooms sheared off cold, and see them making "chicken feed" out of cold railroad rails under a big shear, same as a farmer cuts up straw and cornstalks? Further on in his article Mr. Richards refers to the lightning machinist, and does not seem to get the right conception of the parable. Chordal's lightning machinist was not engaged in trying to treat anything "heroically," but was one of those fellows who was always on the jump himself, never taking time to do anything half right, so consequently did all the sweating, while the machine in his charge did nothing. Chordal at the same time told of another machinist who was one of those deliberate fellows who moved slow but sure, and when he got a tool ready for cutting it cut "heroically."

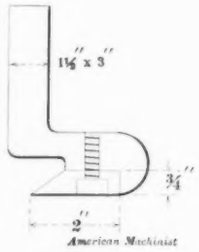


Fig. 2

A BROAD FEED FINISHING TOOL.

There has been little improvement in cutting metal in the lathes or planers since the days of our great grandfather, comparatively, and although "custom is stronger than common sense," the day of grandpa's little diamond point tool, with its microscopic feed, is passing into twilight, and the time is not far distant when we will see a 16-foot pulley turned up as quickly as a 16-inch one is done to-day. Why not? It's only a question of power, tools and brains, and life is too short to be wasted sitting on a nail keg waiting seven hours to see a little round nose tool nibble 10 square feet of surface off the rim of a fly-wheel when it can be done in forty minutes.

Please do not make the mistake of thinking I am a mile-a-minute-cutting-speed advocate, because on heavy cutting I know that you can get off surplus metal faster (iron or steel) by running 13 feet per minute than you can by running 20.

For some time past I have been devoting my attention to reducing costs of machine shop work in various parts of the country, and what most often excites surprise in connection with the work is the very small change required in many cases to double, treble or quadruple the rate at which work is turned out. In most cases it is necessary only to get a little outside of the traditional methods.

W. H. CHAPPELL.
885 N. Sawyer ave., Chicago.

▲ ▲ ▲

Educate the Boys in the Shop.

Editor American Machinist:

In a recent issue of the "American Machinist"—I forget the date—I remember reading an interesting article on making machine screws. While I was at the time interested in the article, I must confess to not remembering so much as I ought to of the subject matter, owing perhaps to one sentence which altogether impressed itself upon my mind. This sentence, which I quote entirely from memory and of course not verbatim, but I think so as to convey the meaning fairly well, was: "Have good men to grind and set the tools and bright boys to supply the machines with stock, test the screws, stop the machines when they are not right and summon one of the 'good men' to see why this is so," viz., to put in another tool and set it, etc.

The testing consisted in seeing that one screw from each bar would screw into one hole and would not screw into another hole.

This sentence, to which so far as the writer in reference is concerned no objection can be taken, has every time I

have thought of it since reading it set me thinking. Heavens, what a life to condemn a "bright boy" too honest to run away from his environments! He may be one of the "bright boys" of the manufacturer for thirty years, and in that time if he has not become an imbecile he may have mastered the art of determining that a screw may be screwed through one hole and cannot be screwed through another, but he will never know why, and it would do him no sort of good if he did. When the screw will screw through neither hole he will know just as much—on the whole he will not know as much—how to arrange matters so that the screw will pass the first hole at the end of his term of service, long or short, as he did at the beginning.

The sentence transports me in imagination to a shop or factory where, thirty-five years ago, I saw twenty-five such boys as the writer speaks of engaged in making, not machine screws, but such taps as were at the time, and may be now for all I know, used by village and perhaps city blacksmiths. The first "boy" that attracted my atention was not less than twenty-three years of age. He was standing by as an uninterested party while one of the "good men" put in a fresh tool and adjusted it for him. Then he went on supplying one of the links of the tap-making mechanism. One of the "good men" referred to him rather proudly as a boy he had ground and adjusted tools for for eight years. A boy eight years at that job! He might have been—and probably was—a "bright boy" at fifteen, but his countenance had taken on that peculiar expression sure to come in later years to the boy who is neither expected nor allowed to know anything.

An inquiry directed to one of the "good men" as to why this boy during all these years had never been instructed in the rather simple mystery which a bright machinist apprentice learns a good deal about in ten minutes and fairly masters in as many hours work, setting his own tools, brought out the altogether frank query: "What would I do?" If I had been framed for a philanthropist and constructed on the strictest plans I should have started in by and probably stopped at sincerely pitying both the "smart boy" and the "good man" without the slightest leaning toward either.

The state very properly objects to men doing certain things, not criminal in themselves, because in the best interests of the community it is better these things be not done. I believe that it is equally in the best interests of the community that as many boys as possible grow up along with something more than one idea, and that a very narrow one. I do not believe that a man has any right to keep a boy forever working in one little rut, all the while educating him to no manner of way of getting out of that rut that grows in no direction except that of depth, and I do not put it on any high morality plane, either. It is contrary to all our ideas of school education, which are so positive that legislation is called upon to enforce it. I believe in the boy making his chances when that is possible, but one in any of our great cities need not look far to find thousands to whom, along the lines of honesty and kindly thought for others, the bare possibility never comes. F. F. H.

▲ ▲ ▲

Repairing a Broken Engine.

Editor American Machinist:

In Pennsylvania a large number of locomotives of special construction are used on the mountain roads for hauling out logs, lumber and bark. They are principally of the Shea geared type, which has three vertical engines located on the right side of the boiler driving a longitudinal shaft. This shaft, by means of universal joints and bevel gears, transmits the motion to the wheels.

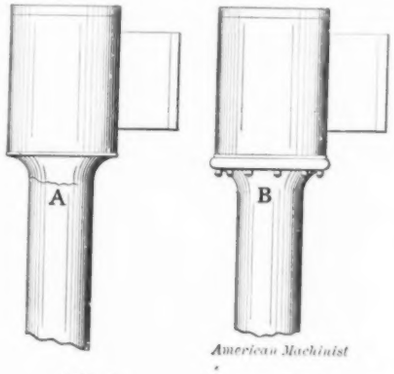


Fig. 1 Fig. 2

REPAIRING A BROKEN LOGGING LOCOMOTIVE.

It is easy to see that these engines have a severe duty imposed on them, as they run very rapidly at comparatively slow speeds of travel, the crank shaft making two revolutions to one of the drivers, which are only about 36 inches in diameter. The reversing gear is the ordinary shifting link motion, and with all these parts in motion at a speed of 20 miles an hour they resemble a sort of fantastic corn chopper more than a locomotive, and the hum of the gearing does not help to dispel the illusion.

The cylinder, steam chest and frame of each engine form one casting, and on the Buffalo and Susquehanna road they have the bad habit of parting company at the point where the frame and cylinder join, shown at *A*, Fig. 1. At first thought it would seem to be not practicable to patch the break substantially—that the whole thing would have to be scrapped, but such is not the case. A special tool has been rigged for cutting off the frames below the lower head and facing the end of the cylinder. A row of stud holes are drilled and tapped, and a new frame with a flanged end, as shown at *B*, Fig. 2, is bolted in place, there being room enough between the end of cross-head travel and the cylinder to permit the change.

This work is done without taking down the engines, by means of portable tools. The cost of the new frame is small beside that of the whole engine, as there is not much machine work on it and it is of course a cheaper casting to make, so that which seems to be an expensive repair is really an economical job. FRED E. ROGERS.

Corning, N. Y.

▲ ▲ ▲

Cost of German Shafting Lines.

Editor American Machinist:

It may be interesting to American readers to know about what good wrought iron shafting costs (1) at the shop where sold, (2) set up ready for drive, with the average distance between hangers, the cost of these being included.

The following figures give (1) the actual diameters in millimeters and in inches (the former exactly, the latter approximately; (2) a coefficient got by dividing the horse-power (*N*)* by the turns per minute (*n*); (3) the weights per running meter in kilograms, and per foot, in pounds of "God's country," and (4) the price in marks per meter and in dollars and cents per foot.†

DIAMETER. mm.	inch.	$\frac{N}{n}$	WEIGHT ‡ kg. per M.	lbs. per foot.	PRICE per meter (Mks.)	per foot. ($)
35	1.4	0.007	7.5	5.	5.	0.36¼
40	1.6	.012	9.8	6.53	6.	.43½
45	1.8	.020	12.5	8.33	7.	.50¾
50	2.	.030	15.3	10.20	9.	.65¼
55	2.2	.044	18.5	13.	10.50	.76
60	2.4	.063	22.	14.67	12.	.87
65	2.6	.085	25.8	17.20	14.	1.01½
70	2.8	.116	30.	20.	17.	1.23¼
75	3.	.151	34.5	23.	19.	1.38
80	3.2	.198	39.	26.	22.	1.56
85	3.3	.251	44.15	29.43	24.50	1.78
90	3.5	.316	49.5	33.	27.	1.96
95	3.7	.400	55.15	36.77	30.	2.18
100	4.	.480	61.	40.67	33.	2.39
110	4.3	0.710	74.	49.30	43.	3.12
130	5.1	1.380	103.	68.67	65.	4.71
150	5.9	2.440	138.	92.	90.	6.53

The usual speeds here are 150 per minute for lines in metal-working shops and 250 in wood-working establishments.

Distances between hangers are reckoned as on the average for shafts under 50 mm. = 2 inches 22 meters = 80 inches; 50 to 70 mm. = 2 inches to 2.8

* The German horse-power is about 0.9863 of ours; one horse-power English is 1.0136 metric horse-power.

† The dollar is reckoned as 4.20 marks, or the mark as $0.238.

‡ One kilogram per running meter may be reckoned as about 0.67 pounds average per running foot; 1 pound average per running foot as 1.53 kilograms per running meter; but in these calculations I have used 0.66 2-3 and 1.50 as the factors; thus making 1 mark per meter = 7¼ cents per foot, nearly.

inches : 2.5 meters = say, 100 inches maximum; over 70 mm. = 2.8 inches : 3 meters, = say, 10 feet maximum.

The cost of the shafts in place is reckoned as follows, on the rough average:

Diam.	50	60	70	80	90	100	mm.
	1.97	2.36	2.76	3.15	3.54	3.94	inches.
Price { Mk.	10.	15.	20.	25.	30.	35.	per meter
	$0.72½	1.08¾	1.45	1.81¼	2.17½	2.53¾	per foot.

ROBERT GRIMSHAW.

Dresden, Germany.

▲ ▲ ▲

Planing a Peculiar Tapered Piece.

Editor American Machinist:

Some time ago I had a block to plane which was required to be about of the dimensions shown in Fig. 1. It will be noticed that the four corners are of different lengths or that the piece tapers in both directions. At the time there was a vise available which had a ball and socket base, and so, after planing the piece to uniform thickness, it was a simple matter to lay off the required lengths on the corners and set up these points parallel to the platen of the planer by means of the surface gage.

Lately the problem presented itself again, but this time there was to be used a Hendey shaper with swivel vise and hinged table which involved some scheming in order to be able to set the vise at the proper angle horizontally and the table at the proper angle vertically to give the required dimensions with certainty. The lines *C I J E*, Fig. 2, represent the piece, in accordance with the principles of descriptive geometry, as having one face in contact with the vertical plane and one in contact with the horizontal plane. With the piece in this position, if we extend the line *C I*, which represents the edge of the piece, to *D*, the line *C D* will be the vertical trace of the upper plane of the piece. The line *K L* pierces the horizontal plane at *G*, and the line *G D* is the horizontal trace of the upper plane of the piece. Now the line *G D* represents the line of intersection between the top and bottom planes of the piece if they were extended. On account of the feed of the tool being parallel to the hinge of the table it will be necessary to so place the vise as to bring this line *G D* parallel to the hinge. If we draw *F E* perpendicular to *G D*, the angle *D E F*, or *a*, will be the required horizontal angle.

The line *E F*, Fig. 2, is also an edge view of the triangle *C F E*, Fig. 1, of which we want to find the angle *b*. If on *E D*, Fig. 2, we lay off *E H*, equal to *E F*, and draw *C H*, then *C H E* shows a side view of the triangle, and from this view we can measure or calculate the required angle *b*. Now the angle *a* is the horizontal angle to which the vise is to be set; and the angle *b* is the vertical angle to which the table is to be set.

It is obviously unwise to go through all this construction for each case, but from the figure we can obtain by trigonometry the following formula, which seems simple enough to be of practical use:

$$\text{Tan. } a = \frac{\text{width (amt. of slant in width)}}{\text{length(amt. of slant in length)}}$$

Having found angle *a*, find from a table its cosine to use in the following:

$$\text{Tan. } b = \frac{\text{amt. of slant in width}}{\text{width (cos } a\text{)}}.$$

It may be convenient to notice that we can call either dimension the length so long as we call the other the width. If instead of the lengths of the corners the dimensions of the piece are given in terms of the angle between the top and bottom when measured at the side and at the end the formulas become:

$$\text{Tan } a = \frac{(\text{width})^2 \text{ tan angle in width}}{(\text{length})^2 \text{ tan angle in length}}$$

$$\text{Tan } b = \frac{\text{tan angle in width}}{\cos a}$$

C. P. BENNS.

Teachers' College, New York City.

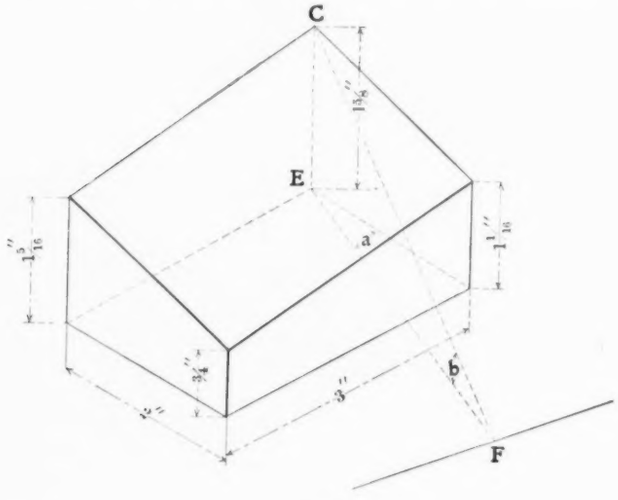


Fig. 1

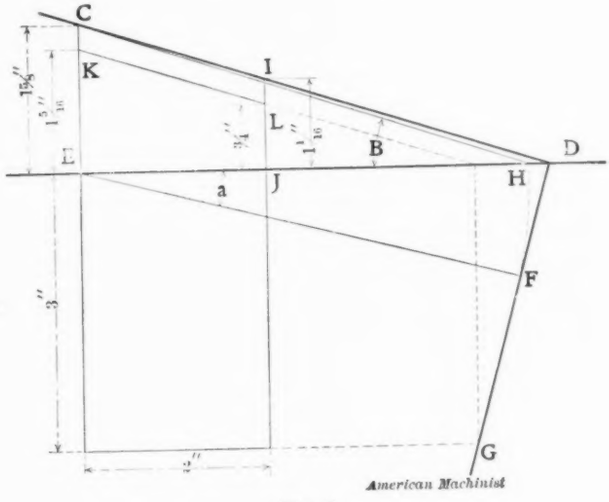


Fig. 2

Ports and Valves for Compressed Air Engines.

Editor American Machinist:

Noting your reply to my question—No. 66, June 23 issue—I wish to state what dimensions I used while waiting for your answer. Having had considerable experience with compressed air I am convinced that the necessary openings for its inlet to a machine of any sort may safely be made very much smaller than is usually thought or done.

The engine in question was from a pattern regularly built by the firm for use with steam. I put a false seat over the valve seat and made the ports as follows: Steam ports, 7-16x2 inches; exhaust port, 1x2 inches; bridges, ⅝ inch; valve, 3 15-16 inches long; cavity, 2x2 inches; valve travel, 1½ inches; feed pipe, ½ inch; exhaust, 1¼ inches. The engine works admirably and handles its heaviest load of 6 tons with ease, and could handle 10 tons if other parts of the crane would permit. As to speed, it has been counted up to 420 per minute with the throttle—½ inch globe valve—but half open. This, of course, was with the empty crane. The speed given in my question—150 revolutions per minute—is about what it ordinarily gets when the molders are using it on foundry work of a general sort.

In the shop we have also a 7x8 engine doing a little heavier work than that mentioned above—from 6 to 10 tons. The ports, valve, piston, etc., are just as would be sent out for use with steam. This engine we feed with a ½ inch pipe and with perfect success as to speed and power. Previous to putting this engine in place there was a double 6x6 link motion engine on the crane, which was fed through a 1¼ inch pipe. The slightest turn of the globe valve handle was sufficient to give the engine enough air for all ordinary work and speed. When the single engine—7x8—was put in place

the old 1¼ inch valve was used again for a throttle, but we were obliged to take it off and put the ½ inch in its place, as the least opening we could in practice get on the large valve would run the engine entirely too fast for a great deal of the molder's work. The ½ inch valve fills the bill in every respect. It ought to be said, too, that the air is conducted to both of these engines through 1½ inch pipe, until a point about 10 feet from the engine is reached, when the reduction is made to 1 inch pipe; and this is reduced to ½ inch at a point about 2 feet from the steam chest. The 1½ inch pipe leading from tank to 7x8 engine is about 40 feet in length. That leading to the 6x6 engine about 60 feet long.

On our air hoists, one of them 16 inches diameter, we use three-way valves with inlet openings ¼ inch in diameter, and get an abundance of air to handle the maximum load with ease and dispatch.

Air pressure is generally 60 pounds, though sometimes, in busy parts of the day, it may get down to 40 pounds for a short time. GEO. W. BERSHEE.

Burlington, Ia.

[Mr. Bershee's experience agrees with that of many others in this matter. There is no doubt that smaller ports can be used with air than with steam, though we are not acquainted with any experiments made to determine how much reduction is admissible.—ED.]

▲ ▲ ▲

Unusual Shapes in Engine Lathe Work.

Editor American Machinist:

I send a few samples of geometrical lathe work which I happen to have on hand. The means employed in producing them are pretty nearly the same as shown in Fig. 4 in the "American Machinist," June 16. I am using an eccentric, driven by the screw cutting gears, which affords a ready means of turning almost any shape. Taper attachment and compound rest are used in connection. Without the latter two no work worth speaking of can be done. A solid eccentric is needed for duplicate work. I am using five now, with throws of 1-16, ⅛, 5-32, 3-16 and ¼ inch. No slack is allowable in any of the working parts. A couple of minutes will make the change from round work to geometrical turning. Fancy shapes take time to turn; elliptical work can be done very nearly as fast as round work. A boring mill or grinding lathe can also be made to do the work.

Until your last paper came to hand I believed that I was alone in the field in this class of work, done regularly on an engine lathe, and I was fully expecting a patent in a short time. It will pay machinists to look closely into this attachment. For fastening anything on a shaft it is away ahead of a key. The ellipse is the most useful, straight or taper. The first use I made of it was on a troublesome propeller; an ellipse with a taper of ⅛ inch to 1 foot ended the trouble. The elliptical drill socket is the machinist's delight; ⅛ inch to 1 foot taper is wanted here also, and the drill and socket will not fall out. The shank need not be as long as with the present standard.

I am not going to enumerate the faults of the key business, but I will promise to fasten anything on a shaft, without a key, for keeps, and not throw the shaft out of true. A press fit, a split hub or a taper split bushing will answer. A square can be turned on a shaft and a hole bored to fit true with it in less time than any other way. With a few eccentrics and a stock of gears (intermittent and elliptical gears may be used) very odd shapes, for cams, dies, etc., may be turned.

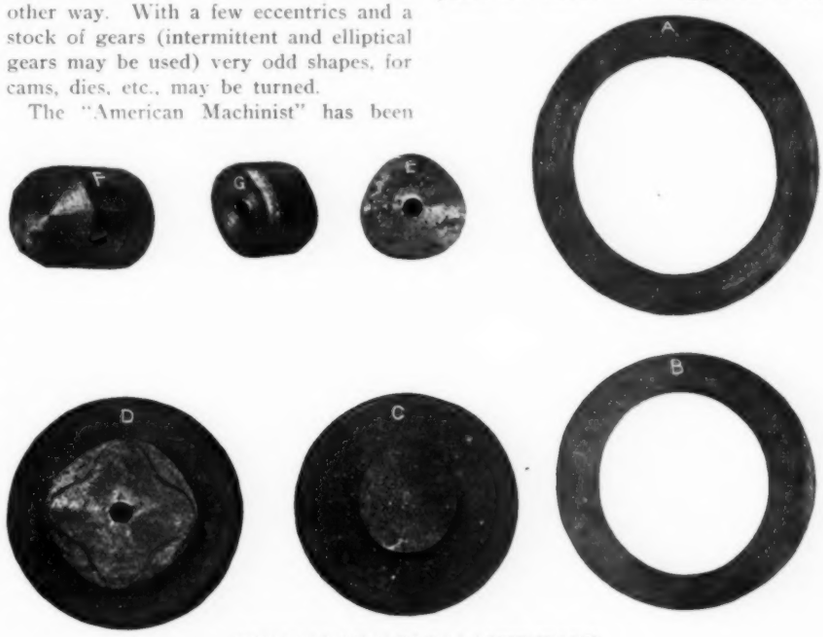
The "American Machinist" has been my friend for years. I thank you for describing the Sulzer shop and some of the Swiss ways. I worked some time in that busy and overcrowded shop years ago, and sometimes I get lonesome and want to go home.

We are doing a great variety of work, new and repairs. The shop belongs to an American company, controlling the water power here and on the American Soo, and operating various industries (about 15,000 horse-power are used now). Everything runs day and night, and of course the shop has to run seven days a week. No wonder a fellow gets lonesome sometimes for a day in Switzerland.

H. DERRER,
Foreman Algoma Iron Works.

Sault Ste. Marie, Ont.

[The collection of specimens shown in the half-tone speak for themselves. *A* is a ring elliptical both inside and out; *B*, elliptical inside and round outside; *C*, a piece with an elliptical hole and a plug fitting it, the plug fitting it equally well when reversed; *D*, a four-sided hole with a four-sided plug fitting it very nicely, and equally well in all four positions; *E*, has a three-sided outline; *F* is a plug one-half elliptical and the other half a decagon, with sharp angles and very nearly straight sides; *G* is an elliptical plug with a screw thread, also elliptical, cut on it, the ellipses being of different dimensions, so that opposite sides of the thread are cut off. The writer of the letter suggests that with a nut having its opposite threads also cut off elliptically it may be used as a slip nut; but it is obvious that the threads could never be made to fit each other. The shapes here spoken of as elliptical are of course not exactly so, as some of our recent correspondents have shown; but for the purposes for which it is suggested to employ them, as in holding wheels securely on shafts, this fact is of no importance.—ED.]



UNUSUAL SHAPES IN LATHE WORK.

▲ ▲ ▲

An Absurd Duty Charge.

Editor American Machinist:

Referring to the article "A Tax on Exports of Machine Tools" in your issue of the 16th ult., I may say that my experience coincides with your information on this subject.

A few months ago I sent some letter stamp blanks to the States to be cut, and the duty paid thereon was $6, being about 100 per cent. of their value. This charge has certainly helped to kill trade with the States in this direction.

HANS RENOLD.

Manchester, England.

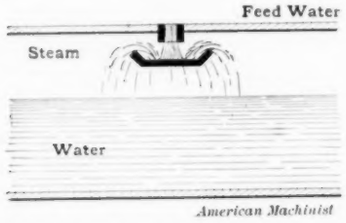
▲ ▲ ▲

The Joseph Dixon Crucible Company is placing on the market a solid belt dressing which comes in round bars and can be applied by simply rubbing one of them upon the belt as it runs. They do not consider this dressing to be as good as that which comes in the form of paste, but it is more convenient and is preferred by many.

Heating Feed Water with Live Steam.

Editor American Machinist:

Referring to "Heating Feed Water by Live Steam," in "American Machinist," page 380, we would say that here in Belgium we have a much better system.



HEATING FEED WATER IN THE BOILER.

We introduce the feed water in a disk which is placed in the upper part of the boiler and is surrounded by steam. The feed water flows in a sheet and is completely heated by the live steam of the boiler, see sketch. Under these circumstance if, for example, you are able to realize an economy of 16 to 19 per cent., we shall attain a greater economy, at least 25 per cent., as we have no loss resulting from condensation or cooling in the steam pipes and in the pipes through which the heated water is forced. Besides, we are realizing a very great economy on the price of the fitting up, as instead of such apparatus as yours we have only a plain cast iron disk.

A. BOLLINCKX.

Brussels, Belgium.

▲ ▲ ▲

Insulating Flexible Coupling.

Editor American Machinist:

In the electric light station at Three Rivers, Que., the writer saw a couple of insulating flexible couplings which seemed well designed for their work.

The generating plant, which is about 16 miles from the town, consists of two 240 K. W. two-phase alternators, each direct-connected to a pair of horizontal water wheels. Step-up transformers raise the voltage from 2,000 to 10,000, and the current is carried on bare wires into the town, where it is lowered again to 2,000 volts.

The turbines and generators are on separate foundations, and in coupling up each set some means had to be provided to allow for any slight variation in alignment and also to insulate the generator from the ground. The accompanying sketch of the coupling shows how this was arranged. The dimensions were taken as the averages of a number of estimates, since no one in the party had a rule.

The coupling consists of two four-armed hubs, each secured to the end of a 4½-inch shaft. These are connected with leather links about 5 inches wide, made of eight thicknesses of heavy double belting, evidently cemented together, and forming a link about 3 inches wide. The pins, about 2½ inches diameter, have washers and cap-screws on their outer ends and are riveted into the arms. One of the pins is shown by dotted lines.

As the maximum input to the generator is about 300 horse-power at 400 revolutions per minute the tangential effort at each pin will be:

$$\frac{300 \times 33000 \times 12}{18 \times \pi \times 400 \times 4} = 1312 \text{ pounds.}$$

The angle between each pair of arms is 45 degrees, and we therefore have a stress in the links greater than that upon the pins, in the inverse proportion to the cosine of half this angle (22½ degrees). This gives as the tension in each link:

$$\frac{1}{.924} \times 1312 = 1420 \text{ pounds.}$$

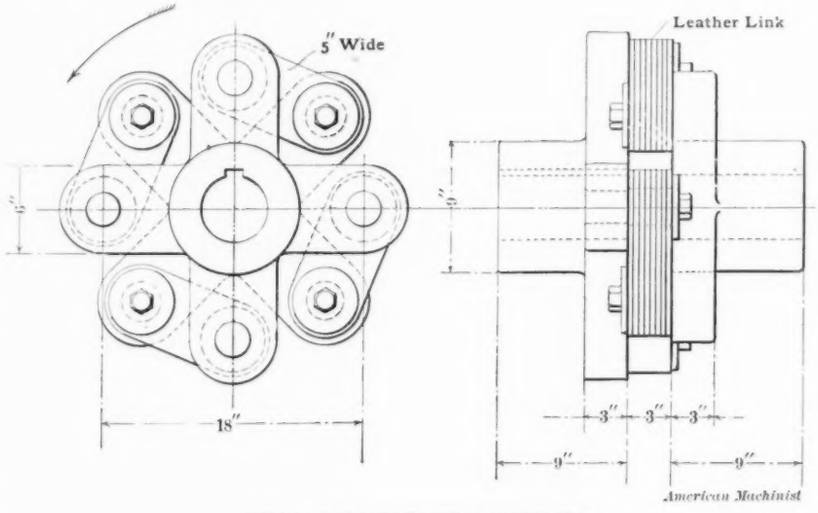
The section at the pins will be $2\frac{1}{2} \times 3 = 7\frac{1}{2}$ square inches, and the tension per square inch in the leather at this point:

$$\frac{1420}{7.5} = 189.5 \text{ pounds.}$$

This, of course, leaves a very large margin for safety.

The coupling looks well and runs well. The Royal Electric Company, of Montreal, Que., installed the electrical, while the Jenckes Machine Company, of Sherbrooke, Que., put in the mechanical equipment. It certainly is a well-arranged station, and the only change one could desire would be to have it nearer some of our manufacturing centers, where it could be properly utilized. In its present location it seems almost too large and complete for the patronage it receives.

WM. SANGSTER.



INSULATING FLEXIBLE COUPLING.

▲ ▲ ▲

A letter at hand from Fenwick Freres, of Paris, states that their exhibit of American machine tools at the recent automobile exhibition was a great success. About one-third of the space allotted to machine tools was occupied by them, and many of the tools were shown in operation.

A Manganese Steel Burglar Proof Safe.

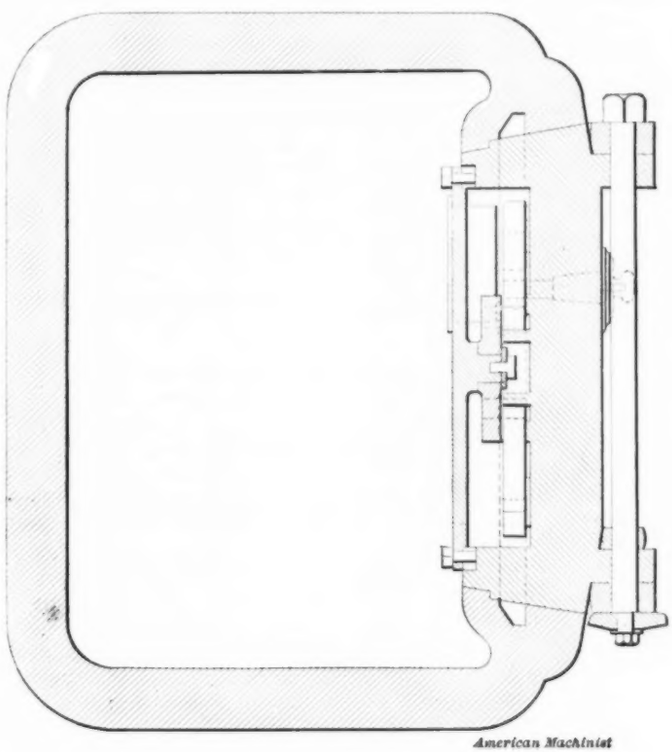
It will be remembered that some time ago we published a number of articles which showed very conclusively that the methods employed by modern safe breakers were sufficiently effective to easily work the destruction of any of the safes or vaults now used that are constructed in the ordinary manner. The facts we presented at that time were published by us simply because they were interesting from the mechanical standpoint, and for the same reason we now give a section of a safe which has been designed especially to obviate the weak points that have been developed by expert and burglarious attacks upon the built-up or laminated construction. This safe is made of only two principal pieces, both of which are heavy sections of manganese steel, the inherent hardness of which is sufficient to prevent drilling and the strength so great as to make the charge of explosive required to produce a breach far beyond any that a burglar could use. For of course a burglar is practically restricted to charges not sufficiently heavy to wreck a vault or building in which the safe may be located or alarm the community.

Manganese steel, as most of our readers know, cannot be softened by heating—in fact, is usually a little harder than ever after being heated and allowed to cool. It cannot be worked cold, and the safe is accordingly made of such form that what work is to be done upon the principal parts can be done by grinding.

The body of the safe is a single casting, of cubical form, with rounded corners, as shown. In front of this is a round opening for the door, which is tapered as shown, and this and the edge of the door are finished by grinding, a specially rigged up boring mill being employed for the purpose.

An annular recess is cast in the metal

surrounding the door opening, and into this recess the bolts which hold the door are projected by the locking mechanism. There are six or more of these bolts, and they are of heavy flat section, strong enough to resist a charge of explosive which would be sufficient to effectually destroy and scatter the safe's contents, supposing it could be introduced for the purpose of forcing the door outward. The bolts are so arranged that any damage done to the locking mechanism is sure to make their withdrawal practically impossible, and of course any required kind of lock is supplied, either combination or clock controlled—"time." The spindles which pass through the door are



A REAL BURGLAR PROOF SAFE.

also of manganese steel fitted by grinding.

At the works of the Taylor Iron & Steel Company, High Bridge, N. J., where the castings composing these safes are made, one of the safes was tested by the explosion of a total of 10½ pounds of Hercules powder containing 75 per cent. nitro-glycerine in eight charges, some of them as great as 3 pounds, and all but one upon the door or joint, without serious effect or making any progress toward the formation of a breach. Tests made by R. A. Hadfield, of Sheffield, England, show that manganese steel possesses a tensile strength of 145,730 to 165,300 pounds per square inch, with an elongation of 24 to 50.7 per cent. in 8 inches and reduction of area of 32 to 36.4 per cent. A test bar can be bent double cold and yet is so hard that it cannot be drilled. The safe is made by Hibbard & Rodman, of 253 Broadway, New York, Mr. Rodman being the expert in high explosives who conducted the official tests for the Government commission whose report we gave some account of in a former issue.

▲ ▲ ▲

Technical Publications.

A POCKETBOOK FOR MECHANICAL ENGINEERS. By D. A. Low. 740 3¼x6 inch pages, with over 1,000 illustrations. Longmans, Green & Co., London and New York. $2 50.

Not many years ago the lack of a really good mechanical engineer's pocketbook was a source of universal comment and regret. At the present rate of production of such books the embarrassment will soon lie in selecting from the multitude rather than in forcibly doing without.

This latest contribution to this class of literature has occupied the author's spare time, we are told in the preface, for five years, and we can well believe it, as well as the further statement that several assistants have been required as computers and draftsmen.

There is no class of book of which it is more difficult to judge by examination of its contents than this. The test of use is necessary to determine how satisfactory the index may be, and how well the data collected together are selected, classified and digested to meet the needs of everyday use. Great care in these respects is manifest from the author's statement of the labor expended in verifying the numerous tables of various kinds, the result of which, he tells us, has been to detect many errors in standard publications.

A feature wherein the book differs from others of the pocketbook class lies in the space devoted to the proportions of machines and machine details, it serving, in this respect, as a manual of machine design as well as of engineering data as commonly understood. The method followed in this particular is that of giving detailed drawings with units and multipliers for the various dimensions.

To Americans who have used and realized the convenience of the diametral pitch system of gear teeth for a quarter of a century, and who have seen that system practically drive the older one out of use for small gears, it is hard to understand how at this late date a book of this kind can be written in England without so much as a word to indicate that such a system exists, and in view of the definite, logical and satisfactory position in which the subject of the strength of gear teeth has been placed by Mr. Lewis, the old line treatment of the subject given by Mr. Low, with stresses recommended varying two and a half to one, but with no guide as to selection except judgment, seems behind the times. It is not of course to be expected in a book covering such an immense field as this that all subjects will be treated in the best possible manner, and it is no reflection on the author of such a book to point out cases of the opposite kind. We take these cases to indicate rather the slowness with which ideas spread, and to show how different practice may be in different parts of the world.

We cannot refrain from remarking that this book, like English technical books in general, indicates the existence of an excellent field in England for some enterprising engraver to introduce the wax process for making line engravings.

CIRCULAR NO. 18: UNITED STATES DEPARTMENT OF AGRICULTURE, DIVISION OF FORESTRY.

The above named circular gives a record of experiments made by Prof. J. B. Johnson at the laboratory of Washington University and an analysis of the same by Mr. S. T. Neely, C.E. The result of Mr. Neely's analysis is the development of a new formula for the breaking strength of timber beams based on the observed crushing strength and the lineal dimensions. The circular includes a table in which the observed strength of beams is compared with the computed strength obtained from Mr. Neely's formula, and the two resulting columns of figures are in striking accordance. The new formula appears to be a real contribution to the subject of the strength of timber.

AMERICAN MACHINIST

Published Thursdays by

American Machinist Publishing Co.,

256 Broadway, New York.
JOHN A. HILL, President and Treasurer.
C. A. HANSMANN, Sec'y.

Editorial Department.

FRED J. MILLER, Chief.

FRANK RICHARDS,
F. A. HALSEY,
EDWARD P. BUFFET, } Associate Editors.

Illustration Department.

A. L. DONNELL, Chief.

Advertising Department.

C. P. DAY, Eastern Representative.
J. M. WAKEMAN, Western Representative.

Foreign Agents:

R. E. HOWARD,
10 Finsbury Square, London, E. C.,
Representative for Great Britain.

FENWICK FRERES & CO.,
21 Rue Martel, Paris,
Representative for France, Belgium, Switzerland and Italy.

WEEKS & JOHNSON,
Lovedoy St., Johannesburg,
Transvaal Republic,
Representative for South Africa.

Space in advertising pages only is for sale.
We invite correspondence on subjects pertaining to machinery.
Name and address must always be given, though not necessarily published.
Communications for or relating to the reading columns should be addressed to the Editor. All business communications should be addressed to the Company.
Subscribers can have their mailing address changed as often as they desire. Send both old and new addresses. Those who fail to receive their papers promptly will please notify us at once. Date on wrappers denotes week with which subscription expires.

Subscription Price:

$3.00 a year in advance, postage prepaid in the United States, Canada and Mexico.

$4.00 a year to other countries, postage prepaid. Entered at Post Office, New York, as second-class mail matter.

For Sale by Newsdealers, Everywhere.
No back numbers beyond 1897.

▲ ▲ ▲

Educate the Boys in the Shop.

On another page of this issue a correspondent takes up the cause of the boys who attend machines in manufacturing establishments, basing his remarks especially upon the occupation of the boys whose duty it becomes to place bars of stock in automatic screw machines and occasionally test a screw as it drops from the machine to see that it screws into the "go in" gage and not into the recently christened "nit" gage.

While there is force in what our friend says, it should be remembered, we think, that in this respect machinists simply follow the general practice of those engaged in other industries. Anyone who wants to see boys employed in what appears to be the most hopeless and soul-withering task possible to be imagined may go to the coal breakers of the anthracite regions and there see boys picking slate out of the coal as it slides, mixed with black water, down chutes.

Under present industrial and economic conditions boys must—many of them—work and must generally take what offers in the way of employment. Many of those who become screw machine tenders would in the absence of that employment pick slate perhaps or perform other work far less pleasant and with much less opportunity for advancement than is offered in a factory where automatic machinery is operated.

There can be no doubt but that the best results in the use of automatic screw and other machines are obtained by having highly skilled men to do everything required to be done to them except placing stock and occasionally gaging the product.

If the boys who operate such machines are allowed to tinker them at discretion the quality of the product deteriorates and the machines are soon demoralized, while if a mere "handy man" is placed in charge of them the result is equally disastrous.

However, as a matter of fact, a process of natural selection does usually go on. The man who has charge of such machines usually finds one or more boys employed upon them who have a natural taste for and ability to handle them, and such boys almost invariably get opportunities to rise, while those who are less intelligent or less ambitious and less interested in the work do not advance, but are probably at least as well off as they would be elsewhere.

If we overlook the fact that natural aptness and ability to do mechanical work differ widely in different individuals we leave out an important factor in all such problems as to how boys should or may be treated. There are boys who resist education in school and are kept at their studies only by parental authority and the expenditure of parental funds. When boys are equally indisposed to take the education the shop affords there is no exterior force that impels them onward. If a boy does not pursue the education of the shop it will not pursue him and he will have to get along without it.

Under proper conditions no one should be required to work at monotonous occupations for such a long period of the day as to give no opportunity for relaxation or variation of employment, but we are not working under ideal conditions.

Where possible to arrange for it we think the plan followed in a Detroit manufacturing concern is a good one. There girls are employed at work which involves the constant repetition of the same movements. They work two hours at a certain work and then two hours at other work, the two sets of girls exchanging places. The results are said to be satisfactory in every way, and the method must do very much to relieve fatigue and the deadly dullness of an occupation consisting of one unvarying sequence of movements.

▲ ▲ ▲

Shop Hospitality.

This is the time when those who have worked diligently and faithfully all through the year are fairly entitled to a vacation, and we hope that all our friends may be able to take it and enjoy it. That an increasing number are so favored year after year is cause for congratulation. The conviction is growing, and very properly, that it is a wise and profitable practice to permit if not to enforce an occasional break in the dull routine of daily life. Individual tastes or various personal circumstances usually determine the direction of the wanderings and the occupation of the time devoted to rest and recreation. Not many are usually physically exhausted by overwork, or will be seeking rest in inaction. A better ultimate rest and renewal will doubtless be found in change of scene and occupation rather than in cessation of activity. It is notorious that vacation time is quite likely to give the subject some new experiences of fatigue. The mechanic of the shop is less likely to spend his time in sleeping and lounging than in wandering along the shore or in sailing the waters of sea or lake, in climbing mountains, in losing himself in the woods. Nature invites in various guise and seldom disappoints her occasional visitors, but many of them know what it is to be tired.

We may assume that the intent for the time is to drop the shop and to put away as far as possible all its cares and concerns. These are the times, however, when shop doors and windows are open, and when the familiar sounds of the shop, the whirr of the shafting, the occasional squeak of a belt or hammer blows of various expression are heard by the passerby. These are inviting sounds to the shop habitué, and it is to be hoped that usually the invitation will not be unheeded. The vacation time is not only one for rest and recreation, but also it is a good time for the absorption of information and stimulus. Every shop is different from every other shop, and in the difference there is always something to learn, and with the visitor it should usually be both give and take. One who goes into a strange shop may carry to it or bring away from it some knowledge of better ways or better means for the doing of certain things, and especially the knowledge may be extended of different lines of work with which one is not familiar. The construction and operation of machinery is in these days a field so vast that no one man's experience can cover more than a little of it, and every man's ideas may be enlarged and his eyes may be opened by a little looking around.

It is well, to our thinking, when the

powers that be indorse the invitation of the open doors and windows which the summer enforces. It is the good American practice to welcome the interested visitor to the shop, and we hope to see it continue. Many have been the gainers and none have been the losers, so far as we know, by the hanging out of the latch-string. The present summer we hope will see many shopmen welcomed in many shops for the mutual benefit of the individuals and for the general stimulus and elevation of the leading business of modern times.

▲ ▲ ▲

The Floating Machine Shop.

We learn that the floating machine shop Vulcan, which, at this writing, is off Santiago with Sampson's fleet, is rendering very important service. In it new steam pipes have been made to replace those shot away, new shafts have been made for gun mounts and an enormous number of small jobs have been done on the torpedo boats, which give more trouble than the larger vessels because they are used as dispatch boats for the fleet, and are in constant and hard service.

This steamer, which was originally the Chatham, was refitted for her present service; there are on board a complete foundry and blacksmith shop, as well as a machine shop. There are two steam cranes, with 10 foot arms, for bringing parts of machinery aboard and discharging them, and among her equipment are plate bending rolls, punches, shears, lathes, planers, drill presses, milling machines, etc.

The vessel's captain is Lieut.-Commander Ira Harris, who was general manager of the Chicago Drop Forge & Foundry Company, and the chief engineers aboard are Gardiner Sims, of Providence, and Prof. W. S. Aldrich, of West Virginia University, Morgantown. A large number of the best mechanics obtainable are on board, and most of them we may expect are having some entirely novel experience.

▲ ▲ ▲

Opposition to labor saving contrivances would not naturally be expected to develop among lawyers. It all depends, however, upon what the contrivance is. The Torrens system of registering land titles, which provides that a real estate owner by paying a moderate fee to a court of registration may have the title of his property searched and secure a State title good for all time unless questioned within one year, has now been adopted in Illinois and Massachusetts. It is said that individual lawyers have exhibited toward the reform a hostility as great as that of manual laborers toward labor-saving machinery. The history of the system is said to show that every class of citizens except lawyers profit by it. Property is much more secure to those who possess it, and those desiring to possess have the expenses and dangers of purchase reduced.

▲ ▲ ▲

An authoritative statement of the present power cost of liquid air is given in an account of the Linde process of liquefaction recently presented before the Paris Academy of Sciences by M. d'Arsonval. An expenditure of a little less than 3 horse-power was stated to produce a liter of liquid air per hour. As a liter is but a little more than a quart (1.05) it may be said that 12 horse-power will produce a gallon of liquid air per hour.

▲ ▲ ▲

Questions and Answers.

Name and address of writer must accompany every question. Questions must pertain to our specialties and be of general interest. We cannot undertake to answer by mail.

(79) J. H. R., Brooklyn, sends sketches of the mechanisms shown herewith and asks whether power will be gained by their use as compared with plain cranks. Both of these are designed for bicycle cranks. Fig. 1 consists of a drum *a* 4 inches in diameter, around which a strap passes and over a small fixed roller *b* and thence to the end of an 8-inch lever *c*, which is pivoted on the same shaft as the drum *a*, but is free to revolve independently of the drum. Fig. 2 is simply a crank bent into the form of a spiral (or clock) spring, and the distance in a straight line from center of axle to center of pedal pin is 7 inches, though the crank is much longer. A.—By the arrangement shown in Fig. 1 the equivalent of a 2-inch crank is secured and by the arrangement of Fig. 2 a 7-inch crank. We might go into an elaborate analysis of the moments of the forces and the actions and reactions of these mechanisms, but such explanations are usually as so much Greek to those who are not able to decide for themselves what the effect of such arrangements is. A simple rule in such matters is to consider the relative velocity at which the different parts of such a mechanism move, and it may be

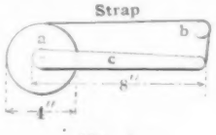


Fig. 1

Fig. 2

depended upon, no matter how complicated or puzzling the mechanism may seem to be, that the force with which any part moves will be in inverse proportion to its velocity of movement. Now applying this rule to Fig. 1 we see that the end of the 8-inch lever will move at the same speed as the surface of the 4-inch drum, and as there is no difference in the velocity of their movement, we may be sure there is no difference in the force with which they move, and the effective crank is of course the one that is fastened to the axle, and that is of 2-inch radius. Similarly in the case of Fig. 2, a little reflection will show that a pedal pin at *d* will have a velocity due to its distance from the center of the crank shaft measured in a straight line, and as this distance is 7 inches the turning force that can be exerted is the same as though the crank were straight and 7 inches long. This method of computing relative forces by relative velocities is of universal application in mechanics. If one part of a machine moves at twice the velocity of another part it will move with half the force or it will require only half the force applied to the faster moving part to stop the machine. Similarly any part of a machine which moves one-fourth as fast as another part moves with four times the force. This is neglecting friction, which of course modifies in some cases and in others does not. In Fig. 1, for instance, some of the power applied to the end of the crank is lost in friction before it reaches the drum, and the device is, therefore, by so much less efficient than a plain 2-inch crank would be.

(80) F. C. S., Guilford, Conn., asks (1) for the calculations necessary to find the load which will bend sheet steel 3-16 inch thick, 5/8 inch wide and overhanging 2½ inches from the support. A.—The breaking load of a cantilever beam loaded at the end is found by the formula

$$P = \frac{R\,b\,d^2}{6\,l}$$

in which

P = Load in pounds;

b = breadth, d = depth, l = length, all in inches;

R = tensile strength in pounds per square inch.

Taking R as equal to 60,000 and substituting the values of b, d and l gives

$$P = \frac{60000 \times \frac{5}{8} \times \frac{9}{256}}{6 \times 2\frac{1}{2}} = 88 \text{ pounds.}$$

If your steel has a higher tensile strength than 60,000 pounds use the proper value in place of 60,000. (2) Why do some formulas give constants for steel of 12,000 while others give 120,000? A.—Obviously the first value was in a formula for the working load, while the second was for the breaking load—the working load being for a factor of safety of 10. The formula above is applicable to the finding of working loads if instead of the value of P it be divided by the desired factor of safety. (3) What are the rules for the size and number of pipes for heating by exhaust steam on the overhead system? I desire to heat a foundry. A.—The rules for the heating (outside) surface used by most engineers provide a certain ratio between this surface in square feet and the volume of the room in cubic feet. This ratio varies between 1 square foot to 50 cubic feet in the case of exposed rooms in isolated dwellings, and 1 square foot to 200 cubic feet, or even more, in the case of churches, large halls, etc., a proportionately smaller amount of surface being required in large rooms. The character of the building must also be taken into account in deciding on the ratio, so that the rule of experience plays a large part. In your case, if your building is fairly well made, we should judge that a ratio of 1 to 100 would be sufficient. For exhaust steam the coils should be made of 1¼-inch pipe. By properly laying out the system any ordinary shop building may be heated by exhaust steam with almost no back pressure. We have not sufficient information to specify the exact plan, but do not have the coils arranged tandem, with the steam blowing through them in succession. Have several independent coils, with a branch pipe to each from the main exhaust. Do not use a barbarous back pressure valve, but put a gate valve in the main exhaust pipe with the branches to the coils between it and the engine, and then partially close this

until steam blows from the outlets of the coils. In this way only so much steam goes through the coils as is necessary to fill them, the remainder going directly to the atmosphere. Do not put the coils too close to walls or ceiling, but allow sufficient space for free circulation of air. Provide an inclination of ¼ inch for each 10 feet of length for drainage. All coils should go around an angle to provide for expansion and contraction, and no unions should be used—close all coils with right and left couplings.

▲ ▲ ▲

New Shops for Kansas State University.

In March of this year the shops of the Kansas State University at Lawrence, Kan., were struck by lightning and destroyed by fire. The calamity was, as frequently happens in such cases, a disguised blessing, although at first hope was paralyzed. The State carried no insurance on the buildings and there was no appropriation available for rebuilding. Now, through the gifts of citizens of Kansas, new shops are provided for and are in process of erection. The buildings, the gift of George A. Fowler, of Kansas City, are to cost $21,000, and $30,000 has been subscribed for tools and machinery. The main building will be of stone, 220x50 feet, two stories and a large attic, and 70 per cent. of the walls will be glass. The machine shop will occupy the principal part of the main floor, and will be fully equipped with samples of all the modern tools. Each shaft will be driven by a separate electric motor. There will be also a large blacksmith shop, brass foundry, woodworking shop, hydraulic laboratory, physical testing laboratory, boiler experimenting and testing room in addition to the main boilers and engines of 150 and 40 horse-power, pumps, etc. The department of physics and engineering comprises Profs. Lucien I. Blake, A. St. T. Dunstan, M. E. Rice and Frank E. Ward. F. O. Martin, Professor of Civil Engineering, will have charge of the physical testing.

▲ ▲ ▲

Foreign News Notes.

A modification of the customs tariff of Norway went into effect on the 1st inst., and among the most important alterations are those applicable to machinery. Under the modified law motors for steam, water, wind, gas, petroleum, benzine, and electricity, dynamos and parts of same will pay 5 per cent. minimum and 10 per cent. maximum. Other machinery, including locomotives, steam fire engines, steam winches, donkey engines, etc., for industrial purposes, technical and agricultural purposes, and for ships' use, also parts of the same, machine packing, cables, straps, sewed belts, etc., all not specifically provided for, minimum duty, free; maximum duty, 10 per cent.

The Russian Government has granted a ten-year exemption from duty to foreign machines or parts of same to be used in gold washing in the Siberian and Ural gold fields.

The total production of cast iron in Russia in 1897 was placed at 4,119,620,848 pounds, or 559,736,000 pounds more than in 1896. The consumption during the year was 6,006,364,516 pounds. It will thus be seen that the home production falls far short of the annual consumption. A. F. T.

▲ ▲ ▲

Meeting of the N. R. R. M. B. Association.

The National Railroad Master Blacksmiths' Association will hold its sixth annual convention in Boston, Mass., September 6, 1898. The American House, situated on Hanover street, has been designated as the official headquarters of the association during their stay in Boston.

GEORGE F. HINKENS.
Secretary.

▲ ▲ ▲

Personal.

Mr. E. E. Wood, formerly chief draftsman for Jones & Lamson Machinery Company, Springfield, Vt., has taken charge of the plant as superintendent.

Our occasional contributor, Mr. E. Sherman Gould, has returned to Yonkers, N. Y., to resume his practice as consulting engineer, after an absence of two months at army headquarters at Tampa and Jacksonville, Fla.

Clarence Livingston Burger has associated with him in the practice of patent and trade mark law Mr. Louis B. Adams, under the firm name of Burger & Adams. The offices of the firm remain in the Postal Telegraph Building, 253 Broadway, New York.

H. R. McGregor, formerly superintendent of the Sprague Electric Company's works, and at present with the Brown & Sharpe Manufacturing Company, has been sent to Scotland to take the position of sales agent recently made vacant by the death of the former incumbent.

▲ ▲ ▲

Inquiries for Machinery.

Those who make, or may know of the makers of such machinery as is called for below, will oblige us by sending name and address, mentioning the number of the inquiry. We cannot forward catalogs. We have inquiries as follows:

59—From England for a machine for polishing steel wire.

▲ ▲ ▲

Boilers as Life Preservers.

A Philadelphia paper publishes the following suggestion from the well-known engineer W. Barnet Le Van:

"Assuming La Bourgogne had six Scotch boilers 13 feet in diameter and 20 feet in length, which is the size of the ordinary steamship boiler; empty, these boilers would contain about 9,000 cubic feet of space. Could this space be utilized as a series of air reservoirs, the empty boilers being practically so many pontoons, the effect upon the sinking ship's buoyancy would certainly be appreciable. A sinking hulk, like the Bourgogne, might have had its life above water prolonged for at least two hours.

"In order to utilize the boilers, special blow-off valves would have to be connected, in series or otherwise, with all the boilers in such a manner as to enable them to be manipulated from the bridge. By the use of these blow-off valves all the water in the boilers could be blown out. The closing of the blow-off cocks and steam valves—from the bridge—would permit the permanent retention of all the air which they were capable of containing, thus making so many pontoons of them.

"For the equipment with this arrangement of a ship like the Bourgogne the expense should not exceed $3,000. Being operated from the bridge, the ship's captain or the mate in charge would always be in position to utilize this safeguard, no matter whether the engineers or firemen did or did not stick to their posts."

After the water had all been blown out there would probably be no way of getting any air into them, and there would be danger of their filling very quickly with water as they cooled off, unless means were taken to prevent it. If all valves could be closed tight just as atmospheric pressure were reached, and if the boilers then became submerged, a vacuum would be produced in them.

▲ ▲ ▲

In commenting upon the loss of La Bourgogne, the New York "Times" alluded to the equally bad if not worse record made by the crew of the North German Lloyd steamer Elbe when she was sunk by collision in the North Sea. Whereupon Mr. Gustav Schwab, whose exact position in connection with the company we do not know, but who seems to be running it, ordered the line's advertising out of the "Times," and instituted a little boycott against it. This will hurt Schwab and his North German Lloyd Company much more than the "Times." The fact is that both the German line and the French line have shown that owing to the discipline they maintain or to the character of the men they employ or both, passengers are not likely to be looked after in time of disaster, but instead fought off and away from the means of rescue. Until some British or American vessel makes an equally black record, those who consult their own safety and that of their families will cross the sea by vessels in which the English language is spoken, and a newspaper does no more than its duty when it

makes the facts known to such of its readers as go abroad. So far no British or American vessel has made such a damning record, and we do not expect that they will. There is only one way for managers of steamship lines to avoid such criticism and that way will be plain to them probably if they will reflect a little.

▲ ▲ ▲

Commercial Review.

NEW YORK, Saturday Evening, July 16, 1898.

MACHINISTS' SUPPLIES

and tangent lines of trade are of course enjoying a short vacation from activity at this season. "Inventory time" has been upon us of late, as well as "midsummer dullness," and one must gage the market rather by the undertone of business and by the amount done as compared with other years than by its absolute volume. Tried by these tests it is not without features of encouragement. Indeed we think that it is in a position to be congratulated upon the extent to which it has held its own since the beginning of the war. Everything now depends upon the question of peace, and if the present auguries therefor do not prove deceitful the supply business, like other lines, ought to begin the month of September under circumstances that will lead to a prosperous autumn.

The head of a wholesale wood-pulley house gives us a summary of his observations among the middlemen with whom he has recently conversed, as follows: "The outlook is bright. Jobbers look for a good fall trade. Some of them are sure of it. Plumbers, steam-fitters, machinists, etc., in this city, with whom I have talked are confident. They have come to their temporary summer shut-down, but some of them have run longer than usual before suspending operations, and have accumulated a considerable amount of stock, for which they anticipate a demand after the summer is over. Therefore they have entered upon their resting period in a spirit of cheerfulness. One of them speaks of some twenty builders who have ceased operations, but that does not worry him, since he feels that the cessation of activity would be only for a brief time."

File-makers talk a little conservatively, as is natural at this season, but they say that they look for a good autumn trade. A remark is made that large files are in pretty good demand for this time of year, indicating a fair activity in the machine shops. We are advised that the Arcade File Works have made their suspension of operations for stock taking this year shorter than usual.

At the last meeting of the File Manufacturers' Association of the United States it was unanimously agreed, owing to the advancing tendency of labor and raw material, to maintain existing prices for the present and to hold a meeting in New York city August 3, to consider the question of advancing prices. When, about a year ago, files were marked up a flurry in demand took place in anticipation of the increase, and possibly, if the makers decide upon an advance next month, some buyers will wish to order their stocks before it can take effect.

A good deal of the Government buying of supplies for the present war has consisted of rush orders, and lucky has he been who has had the material on hand. A great variety of goods have been called for. Waste, for instance, has been bought by the bale, presumably to use for fenders in coaling vessels. Many forges have been purchased for the navy. One house in this city, James Beggs & Co., has sold about sixty. An order for thirty-eight came to it on Monday of this week, and in less than three days they were shipped. This concern furnished not a few of the twenty-seven that were put on board the St. Paul, and a day or two ago it shipped a consignment of tools for the Panama, one of the prize vessels.

"The demand for agricultural goods could not be better than now," remarks a member of a firm handling certain specialties in that line, as well as in machinists' supplies.

POWER TRANSMITTING AND GRAIN HANDLING MACHINERY.

The power transmitting machinery business, although in some quarters temporarily rather slack in sales of wood pulleys, and by inference in other lines, is marked by some most gratifying reports from large concerns which are well filled with work. Particularly does this seem to be the case, however, in grain conveying machinery, which is flourishing with the crops.

The Webster Manufacturing Company, Chicago, New York office, 38 Dey street, which makes a specialty of grain handling machinery, has increased its plant in the past six weeks by adding a large amount of machinery, including a 16-foot Niles boring mill and a considerable number of radial drills, in part of the same make. The foundry capacity has been increased to 40 tons per day. This is the most prosperous year the company has known in the twenty-two years of its existence, and the present is a busy season of the year. The works are on night turn. Recent contracts include one to equip a 1,000,000 bushel grain elevator to be erected at East St. Louis, Ill., and one to equip a 500,000 bushel annex of the Philadelphia Grain Elevator Company's, at Philadelphia. The latter amounts to about $15,000. The Webster Manufacturing Company has just put a $45,000 equipment in the McCormick Stores, Brooklyn, controlled by the Brooklyn Wharf & Warehouse Company. It comprises twenty-four rope drives, with six towers, and is capable of unloading and handling 280 carloads of grain per day. Six months' time was allowed for the execution of the contract, but it was actually completed in three. The gas engine sales of the concern are excellent, and there is a

Continued on page 36.

▲ ▲ ▲

Business Specials.

Gear wheels, gear cutting. Grant; see page 16.

Forming Lathes. Mer. Mach. Tool Co., Meriden, Conn.

Selden Packing for stuffing box, with or without rubber core. Randolph Brandt, 38 Cortlandt st., N. Y.

Cutters, reamers and small tools, regular and special; vertical millers, cutter and surface grinders, shears and punches. R. M. Clough, Tolland, Conn.

Wants.

Situations and Help Advertisements only inserted under this head. Rate 30 cents a line for each insertion. About seven words make a line. The cash and copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Situations Wanted.

Position as draftsman by a young man with five years' shop experience. Box 150, AM. MACHINIST.

Superintendent that can handle men and design up-to-date machinery and tools wants a Western position. Box 148, AMERICAN MACHINIST.

Foreman patternmaker, good education and long experience, thoroughly competent to take charge of any class of work, desires situation. Box 140, AM. MACH.

Shop supt. with a practical engineering and business experience is open to a change; can design, make sales, or handle office; age 38; exceptional references. Address Box 128, care of AMERICAN MACHINIST.

Wanted—Position as foreman by first-class mechanic; 12 years' exp. on fine tool work, such as gun, sewing machine and bicycle tools; 4 years as foreman; best reference. Box 153, AMERICAN MACHINIST.

Engineer—Good executive and business ability; familiar shop management; costs; long exp., design, manf all kinds elevators; special hyd., elec. mch'y, desires position. Address Box 151, AM. MACHINIST.

A mech. eng. with thirty years' exp. as shop foreman, gen. supt. and later as manager for a manufacturing concern, desires a pos. in any of the above capacities. Address Bullard, S. E. M. Co., Pittsfield, Mass.

Wanted—Position by a first class brass molder, capable of taking charge; mixes all classes of metals; first-class in all details of shop work; light or heavy castings, core work, etc. Box 147, AM. MACHINIST.

Wanted—A position as foreman or draftsman where a thorough knowledge of the design construction and erection of cold storage or refrigerating plants of small and medium capacity is needed; results guaranteed. Box 145, AMERICAN MACHINIST.

Wanted—Situation by young man who has had thorough exp. in pattern storing department of foundry which is connected with one of the largest mfg. concerns in New England and which is modern and systematic in all its details. Box 143, AM. MACHINIST.

Wanted—By mechanical engineer and draftman a place as master mechanic, foreman or supt. of any manufacturing place or machine shop; have had charge of drafting dept. of 34 men for 11 years; can give best of references. Box 144, AMERICAN MACHINIST.

A modern machinist wants position on turret lathe work; competent to respond for department; familiar with all leading machines, and can get out the latest tools and fittings for same; New York or New England preferred; best ref. Address Box 154, AM. MACHINIST.

Former superintendent of bicycle, engine and boiler works and master mechanic general jobbing shop wishes to travel or start branch machinery store in Buffalo, or will take partner with $2,000 and start general jobbing shop. Address Shimer, 89 North street, Buffalo, N. Y.

Help Wanted.

Wanted—Machinists, fitters, forgemen and blacksmiths for heavy machine shop work; steady work for competent men. Address Box 149, AM. MACHINIST.

Wanted—Foreman for machine shop of large electrical establishment; one having held similar position before preferred; in answer state experience, wages required, &c. Address Box No. 152, AM. MACHINIST.

Wanted—Mechanical draftsman having experience in designing machinery and capable of taking charge of drawing room employing four men; state exp., ref. and salary expected. Address Box 146, AM. MACHINIST.

Wanted—Experienced forger and blacksmith as foreman of shop; heavy and light work; good position; steady work for right party. Address, giving references and full particulars, P. O. Box 452, Pittsburg, Pa.

Chuck Manufacturer—Wanted first-class machinist used to latest methods in above; state fully what experience in this line and in what shops, age and salary expected; replies treated in confidence. Box 129, care of AMERICAN MACHINIST.

Continued from page 35.

good demand for cotton seed oil machinery in the South.

The Hecker-Jones-Jewell Milling Company, of this city, has bought quite a large amount of machinery from A. & F. Brown, a portion of which has already been delivered. The Browns are the manufacturers of a patent fog-horn, or siren, a considerable number of which have lately been ordered for war vessels, as well as certain special ones for lighthouse work.

The Brooklyn Wharf & Warehouse Company is about to place more contracts for grain elevator machinery, and more than one local concern is estimating thereupon.

Another important contract now being bid upon is that to furnish power transmitting machinery for new paper and pulp mills to be erected at Erie, Pa., for Ernst R. Behrend & Co., of Germany, to the engine contract for which we alluded to in a previous article. The pulp and paper machinery contractor for this plant is the Pusey & Jones Company, Wilmington, Del. This machinery, it is said, will weigh 660 tons and require about forty cars to transport it. The buildings will cover a tract about 300x600 feet, and are being substantially constructed of stone, brick and steel, arranged with the prospect of future enlargement.

MISCELLANEOUS.

Contracts for gun carriages for the War Department have lately been awarded as follows: Morgan Engineering Company, Alliance, Ohio, five 12-inch carriages at $32,250 each; Bethlehem Iron Company, South Bethlehem, Pa., five 12-inch carriages at $32,250 each; Robert Pool & Sons Company, Baltimore, Md., nine 12-inch carriages at $32,250 each; the Walker Company, Cleveland, Ohio, two 8-inch carriages at $10,000 each; Lake Erie Engineering Company, Buffalo, N. Y., four 8-inch carriages at $10,850 each.

The board of metropolitan sewerage commissioners of Massachusetts will, until noon, September 3, receive bids for furnishing to each of the pumping stations at Deer Island, East Boston, and Charleston one engine, or set of engines, and two horizontal tubular boilers.

CHICAGO MACHINERY MARKET.

Cropping up here and there are constant references to Government work, and the aggregate is doubtless quite large. Some machinery tools were sold last week to several plants that are making projectiles for the army and navy. This work has been undertaken as a temporary makeshift by manufacturers, who otherwise would be idle in this dull season. Even bicycle factories are now engaged in thus turning out shells for the service against Spain. The adaptation

Continued on page 37.

Help Wanted—Continued.

Wanted—A large Chicago manufacturer wants a first-class machine shop foreman; one who understands handling men and modern machine shop practice; must be a hustler; no other need apply. Address Box 123, AMERICAN MACHINIST.

Wanted—By a New England manufacturing company first-class draftsmen to design standard machine tools, such as lathes, planers, shapers, screw machines, milling machines, etc., and who know thoroughly the requirements for a first-class product; men who have had both shop and drawing room experience preferred. Address, giving experience in detail, wages expected and references, Box 142, AMERICAN MACHINIST.

Miscellaneous Wants.

Advertisements will be inserted under this head at 30 cents per line, each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Best Calipers, Levels, etc. E. G. Smith, Columbia, Pa.

Book, Dies & Die Making, $1. J. L. Lucas, Prov., R. I.

The Dutton Wet Twist Drill-Grinder is sold by the Garvin Machine Co., New York City.

Best and cheapest Bolt Header, made by Baush & Harris Machine Tool Co., Springfield, Mass.

Light and fine mach'y to order; models and electrical work specialty. E. O. Chase, Newark, N. J.

Die makers, special mach'y and spec'lt'es wanted for manufacture. Town Mach Works, Battle Creek, Mich.

For Sale—One Merriman bolt cutter, 3-8 in. to 1 1-2 in.; one 1-2 in. to 2 in.—new. The McLagon Foundry Co., New Haven, Conn.

The advertising department of the American Machinist has on hand 20,000 draftsm'n's thumb tacks; will send a box of ten to any draftsman in America on request; could use a postage stamp on box, but will send the tacks anyway.

For Sale—14 in. x 8 ft. Reed engine lathe, together with chucks, tools, &c., and a 16 x 42 in. Bridgeport planer; have not been used more than three months and are in first-class shape. Crocker & Lawson, 17 Ferry street, Binghamton, N. Y.

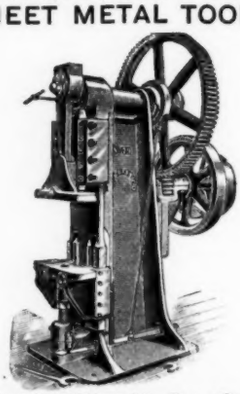
Institutions retiring from business having machine tools, brass or wood working machinery, will find it to their interest to correspond with us. We purchase complete plants or handle them on com. C. C. Wormer Mach Co., 55-59 Woodbridge st., W., Detroit, Mich.

Wanted—Agency or to manufacture for England for thoroughly first-class feed water purifier and scale preventer; advertisers have splendid connection among manufacturers. Full particulars to Filter, care of Messrs. C. Mitchell & Co., Red Lion Court, Fleet Street, London, England.

IMPROVED 16' & 18' ENGINE LATHES

RAHN & MAYER
216 W. Pearl St.,
CINCINNATI,
OHIO, U. S. A.

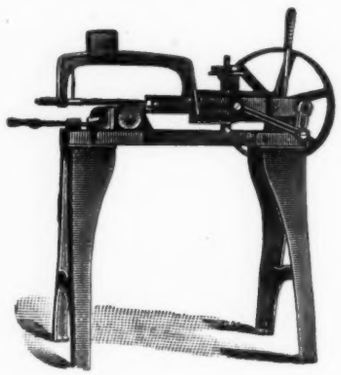
E. W. BLISS CO.
1 Adams Street, Brooklyn, N. Y.
WESTERN OFFICE: 96 W. Washington St., Chicago, Ill.
EUROPEAN OFFICE:
39 Rue Caumartin, Paris, France. A. WILZIN, Manager.
SHEET METAL TOOLS.



"Bliss" No. 79 Broaching Press (Pat'd).
PRESSES, DROP HAMMERS, DIES AND SPECIAL MACHINERY.
Owners of the Stiles & Parker Press Co.
Manufacturers of the WALDRON FRICTION CLUTCHES.

"The best is as good as any."

The New
Automatic and Gravity Feed
Q & C Shop Saw



Cuts { Tool Steel, Machinery Steel, Iron, Brass and All Other Metals.

Price—'Way Down.
Quality—'Way Up.

Shop Saws,
Portable Rail Saws,
Cold Power Saws,
For All Purposes.

Send for Catalogue.

Q & C Company,
Chicago. New York.

LONDON: Chas. Churchill & Co.
PARIS: Hounsfield & Fils.
BERLIN: Schuchardt & Schutte
MADRID: J. G. Neville & Co

Continued from page 36.

serves to illustrate the possibilities of our defensive resources if the occasion demanded.

No change has come over the situation in the general machinery trade that deserves extended notice. The railroads are a trifle busier if anything, and are making every effort to bring their equipment up to the highest possible state of efficiency for the moving of the crop now being harvested. Each car that will bear use is being overhauled and pressed into service, and the side tracks in the West are filling up with cars in anticipation of the movement. But the carriers are not adding materially to the capacity of their shops, and the demand for new machinery is therefore not large.

In a small way it is said that the trade in bicycle fittings is promising. The making of wheels is drifting into the large plants, but quite distinct from this there is growing up a demand for special work, which is feeding the small shops of the better class, and the machinery houses that look after this trade are doing a satisfactory business. The large work has been likened to ready-made clothing and the special work to merchant tailoring.

The crude iron market is active and weak. In spite of the large transactions that are of weekly occurrence prices show scarcely any elasticity, and material of all kinds can be purchased about as low as ever. The railroads are heavy buyers of track material and of cars. Local railway track elevation is consuming a heavy tonnage of structural shapes. But the trade is mainly that of well-established concerns. New enterprises are still sleeping.

The Armstrong Tool Company has just received an order from jobber at Moscow, Russia, for a considerable stock of tools. This company has previously sold to a number of users in Russia, but their jobbing trade there is just becoming well established.

The W. A. Jones Foundry Company reports an active trade in shafting, rope transmission power, etc. The present tendency is toward improvement. The chief buyers of the rope transmission are old users, who are extending its application in their factories and shops.

▲ ▲ ▲

Quotations.

NEW YORK, Monday, July 18.

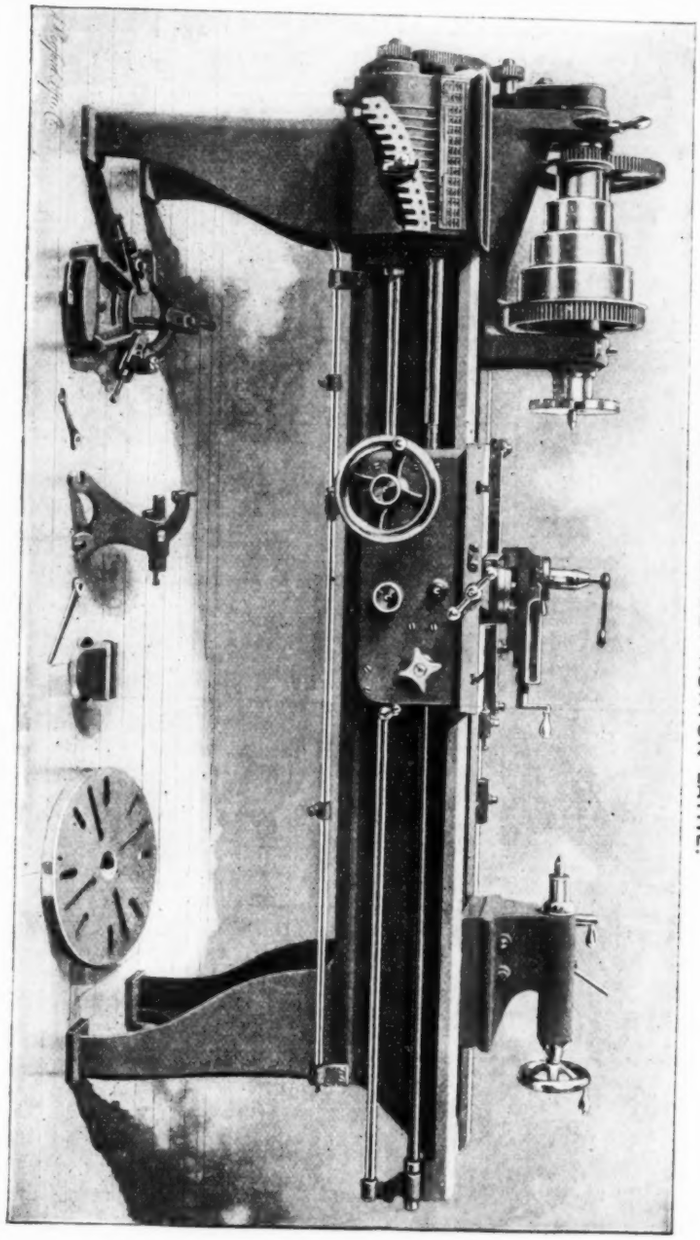
Iron—American pig, tidewater delivery:

No. 1 foundry, Northern	$11 00 @ 11 25
No. 2 foundry, Northern	10 50 @ 11 00
No. 2 plain, Northern	10 00 @ 10 50
Gray forge, Northern	9 75 @ 10 00
No. 1 foundry, Southern	10 50 @ 10 75
No. 2 foundry, Southern	10 00 @ 10 25
No. 3 foundry, Southern	9 75 @ 10 25
No. 1 soft, Southern	10 50 @ 10 75
No. 2 soft, Southern	10 00 @ 10 25
Foundry Forge, Southern	9 50 @ 9 75

Bar Iron—Base—Mill price, in carloads, on dock: Common, 1.05 @ 1.10c.; refined, 1.10 @ 1.20c. Store prices: Common, 1.25 @ 1.35c.; refined, 1.30 @ 1.50c.

Tool Steel—Base Sizes—Standard quality, 6 @

Continued on page 38.



18-INCH HENDEY-NORTON LATHE.

ALL these Lathes have the Norton Screw Cutting feature. All the different threads and feeds in daily use obtained by moving the handle in gear box from one notch to the other. All sizes but the 32 in fitted with our Automatic Stop Rod for carriage. By its use you can cut threads to and from shoulders and always have the carriage stop in the same place. All lathes have the reverse motion in head, operated by lever at side of apron. By this you reverse the carriage only, which is all that is necessary in cutting threads.

These attachments mean a great saving of time and labor.

THE HENDEY MACHINE CO.,
Torrington, Conn.

AGENTS FOR THE PACIFIC COAST:
PACIFIC TOOL & SUPPLY CO., . . San Francisco, Cal.
J. W. CREGAR, . . Philadelphia Bourse Exhibition.

EUROPEAN AGENTS:
SCHUCHARDT & SCHUTTE, Berlin, Vienna, Brussels, Stockholm.
CHAS. CHURCHILL & CO., Ltd., London and Birmingham, England.
ADOLPHE JANSSENS, . . . Paris, France.

Quotations continued from page 37.

7c., with some brands perhaps a little less; extra grades, 11 @ 12c.; special grades, 16c. and upward.

Machinery Steel—Ordinary brands, from store, in small lots, 1.45 @ 1.50c.

Cold Rolled Steel Shafting—Base sizes, from store, 2.05 @ 2.10c., according to quantity.

Copper—Carload lots: Lake Superior ingot, 11½ @ 11¾c.; electrolytic and casting copper, 11⅜ @ 11⅝c.

Pig Lead—Carload lots, 3.95 @ 4.00c., f. o. b., New York.

Pig Tin—For 5 and 10 ton lots, 15.65 @ 15.70c., f. o. b.

Spelter—Carload lots, 4.60 @ 4.62½c., New York delivery, for ordinary brands.

Antimony—In cask lots: Cookson's, 9⅝ @ 9¾c.; Hallett's and French E. B., 9c.; United States, 8¾ @ 9c.

Lard Oil—Prime city, ice pressed, 50 @ 51c., in wholesale lots.

▲ ▲ ▲

Manufacturers.

The Huntsville Cotton Mills, Huntsville, Ala., will expend $7,000 in machinery.

The Engleworth (N. C.) Mills will build an addition and install eighty more looms.

L. E. Westcott, paper manufacturer, Delphos, Ohio, is to build a new mill at Columbus.

Fire caused a loss of $3,500 in the North Chicago Street Railroad Company's machine shops, Fullerton and Sheffield avenues, the 9th inst.

Lieut.-Gov. G. T. Jester, of Texas, is interesting himself in cotton manufacturing, and will endeavor to have a plant of that character established in Corsicana.

Mr. Bradshaw, of Burkeville, Va., is getting ready to build a factory for the manufacture of barrel heads, crates, etc. The factory is to be a two story structure 60x40 feet.

William Barker has awarded the contracts for the erection of a new $30,000 knitting mill on Broadway, in Watervliet, N. Y., and is in the market for the necessary machinery.

Wehadkee Cotton Mills, Rock Mills, Ala., will install a 140 horse-power boiler and engine this month, which were recently contracted for. Some new textile machinery may be added in the near future.

The M. A. Smith Manufacturing Company, of Scotland Neck, N. C., contemplates installing more machinery in its plant. This is a new enterprise, having been in operation but two months.

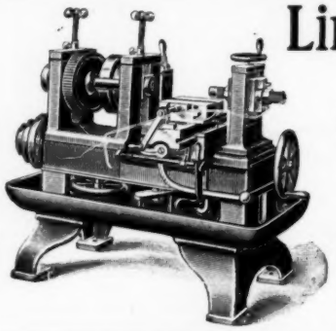
The directors of the Abbeville Cotton Mills, of Abbeville, S. C., consider certain proposed improvements. It has been contemplated to add thirty more looms and other machinery, including an electric lighting plant.

The insurance on the plant and stock of the Globe Refining Company, Louisville, Ky., which burned the 3d inst., foots up to $60,400, of which $37,400 was on the plant and $23,000 on the stock. The company will rebuild at once on a large scale.

The Riter-Conley Company has been granted a permit for the construction of an additional iron shop in Allegheny. It will be located on Preble avenue, and is to cost about $12,000. Increased business has made necessary the building of the shop.

The Friction Draft Gear Company, Pittsburg, capital $10,000, was chartered at Harrisburg a few days since. The directors are George Westinghouse, W. D. Updegraff, Frank Moore, Pittsburg; H. H. Westinghouse, Edgewood, and M. K. Garrett, Wilkinsburg.

A new firm for the manufacture of buggy, carriage and wagon materials has secured a contract for a plant at P street and the L. and N. crossing, Louisville, Ky. It is capitalized at $38,000, and the officers are Sam W. Russell, president; Ossian P. Ward, vice-president, and



Lincoln Milling Machine

COLT'S MODEL, 1897.

With Foot Stock, Vise, Pan and Patent Adjustable Stop Mechanism that prevents breakage of mill teeth when the work is run up to the cutters.

Column Milling Machines in four sizes.

GRANT Single and Double Head Milling Machines, Vertical Spindle and Circular Milling Machines in variety, Milling Cutters, Milling Machine Vises and Centers.

Ask for the "Machinist's" Catalogue.

THE PRATT & WHITNEY COMPANY,
HARTFORD, CONN., U. S. A.

NEW YORK: 123 Liberty St. BOSTON: 144 Pearl St. CHICAGO: 42 South Clinton St. LONDON, England: Buck & Hickman, 280 Whitechapel Road. PARIS, France: Fenwick Freres & Co., 21 Rue Martel.

Jenkins Standard '96 Packing

weighs 33-1/3 per cent. less, does not **Rot, Burn** or **Blow Out,** and will last longer than other joint packings; therefore the cheapest and best for all purposes.

Good buyers compare weights.
Genuine stamped like cut.

JENKINS BROS., New York, Boston, Philadelphia, Chicago.

Slide-Valves. A book for practical men on the Principles and Methods of Design; with an Explanation of the Principles of Shaft Governors. By C. W. MacCord, Jr., M. E. First Edition. First thousand. 8vo. Cloth. 168 pages and 101 illustrations. $2.00.

JOHN WILEY & SONS, New York City.

Fine Reamers, Taps, Dies and Screw Plates
IN GREAT VARIETY.
"Lightning" and "Green River" Brands.
SEND FOR CATALOGUE.
WILEY & RUSSELL MFG. CO.,
GREENFIELD, MASS., U. S. A.
Agents in London, Selig, Sonnenthal & Co., 83 Queen Victoria St.

THE BRADFORD BELTING CO.
CINCINNATI, OHIO, U. S. A.
"MONARCH" RIVETLESS LEATHER BELTING.
Write for Catalog "A."

J. M. ALLEN, President.
WM. B. FRANKLIN, Vice-President.
F. B. ALLEN, Second Vice-President.
J. B. PIERCE, Secretary and Treasurer.

GANG'S RADIAL DRILLS.

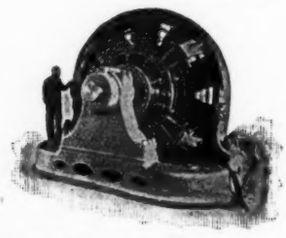
WM. E. GANG & CO.,
1108 Harrison Ave.,
CINCINNATI, OHIO, U. S. A.

See last week's issue

WALKER COMPANY

ELECTRICALLY DRIVEN

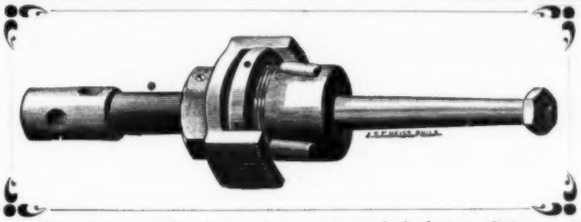
Cranes and Hoists,
Motors for Mills
and Factories.



Generators for
Lighting and Power,
Mining Machinery, Etc.

CLEVELAND, OHIO.

We Make **Boring Machines, Milling Machines, Special Tools** BEAMAN & SMITH, PROVIDENCE, R. I.



THE LATEST EXPANDER.

Is self-feeding, requires no hammering, superior in every way.

Can be used in close places where it is impossible to drive mandrel. Made right or left hand. A good line of Jacks and Punches.

A. L. HENDERER'S SONS,
85 Maryland Avenue, Wilmington, Del., U. S. A.
A. W. Secor, Agent, 123 Liberty Street, New York.

Fay & Scott make a great many Engine Lathes.—28" and 32" Especially.

That is, more than a great many people think we do; and they're good Lathes, that is, people who use them say so; and they're reasonable in price, that is, they're not too high nor are they the cheap kind, as cheap is usually understood. That they are to be depended upon is one of the strong points with users. Any way, before you buy, why not let us send you the particulars; there might be money saved by finding out from us just what they're like?

Fay & Scott, Dexter, Maine, U. S. A.
Hill, Clarke & Co., Boston.
Prentiss Tool & Supply Co., New York.

This is the Frisbie Friction Clutch,

and it is considerably better than any other Friction Clutch made. They're no new scheme in Clutches for you to experiment with for the makers' benefit; they've been made for years, and between 8,000 and 9,000 of these Clutches are now in use, giving the greatest satisfaction.

The Eastern Machinery Co., New Haven, Conn., U. S. A.

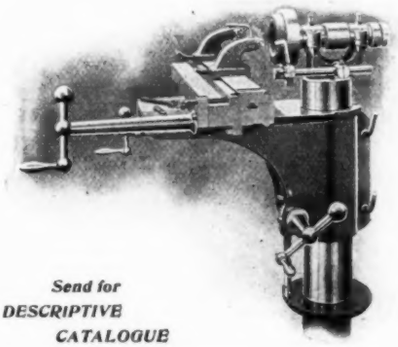
Pipe Threading Machinery

with adjustable quick releasing dies. Simplest die mechanism known and the accuracy of its work cannot be controverted. Dies may be instantly adjusted to the minutest degree without aid of tools.

An interesting catalogue free upon application.

BIGNALL & KEELER MFG. CO., Edwardsville, Ill., U. S. A.

Cut showing how to grind milling Cutters. We use cup wheel.



Send for DESCRIPTIVE CATALOGUE

New Universal Grinder.
WELL BROS. & CO., GREENFIELD, MASS.

A P4 Planer is

the best kind of a planer to use, because you can handle such a quantity of work on it, and can do so many things that are impossible with other planers. A cheap, first cost Planer is not necessarily an economical one, rather the opposite in nine cases out of ten. P'raps you know this. Maybe you've bought your planer experience. Almost everyone can tell you about Whitney tools.

Baxter D. Whitney,
Winchendon, Mass., U. S. A.

SENSITIVE UPRIGHT DRILLS.

Four Styles. Also Tool Grinders.
H. G. BARR & CO.,
51 Union Street, Worcester, Mass.
Quick Sales. Catalogue B. Small Profits.

J. W. Von Behren, general manager. Operations will probably begin September 1.

Alonzo G. Collins, Pabst Building, Milwaukee, Wis., is making plans for remodeling the steam plant of the B. J. Johnson Soap Company, Milwaukee, Wis., which will include a 100 horsepower boiler and an addition to the boiler house.

The Todd Manufacturing Company, of New Albany, Ind., has filed articles of incorporation with a capital stock of $20,000. Ex-Mayor George Todd, of Louisville, is the principal stockholder. The company will manufacture engines, machinery and mechanical devices.

The officers of the United States Headlight Company have decided to move the headquarters of that concern from Utica to Buffalo, N. Y. The company has leased one of the large buildings on Niagara street, near Maryland, and will at once begin equipping it with machinery.

Arthur Chapman is building a new feed and grist mill on the site of the old Pine Run Valley (Pa.) mill, recently destroyed by fire. It will be a modern building of brick and stone, and considerably larger and very much more convenient than the old mill. New flouring machinery will be introduced.

The Hamilton (Ont.) Coffee & Spice Company is about to erect a new mill. The plant will be up to date in every respect, with modern machinery and appliances. The building will be of brick, very commodious and especially arranged for the baking powder, spice and coffee business, and also for quick handling of large quantities of goods.

George C. Deitrich, of Philadelphia, has the contract to build the new cotton and hosiery mill of Frederick Rumpf & Sons, at Langhorne Station, Pa. A large force of men are at work on the building. It is 80x404 feet, and will be three stories high. The walls are of stone. The works will be connected with the Reading Railroad by a side track.

The Wellsville (Ohio) Plate & Sheet Iron Company has purchased additional property, and intend erecting new buildings both to the east and west of their present buildings. The plant is running seven mills full at present, three crews at eight hours each. The mid-summer shut down will be omitted this year, and before the summer is over several more new mills will be started.

Architect J. Franklin Stuckert & Son, 49 North Thirteenth street, is finishing plans and specifications for an addition to the factory building at Berks and Fourth streets, Philadelphia, for Querns Brothers. The same will be three stories and basement, brick and iron construction, and owners will install up-to-date machinery in the same. New heating, lighting, plumbing, roofing, flooring, wash basins, closets, etc., included.

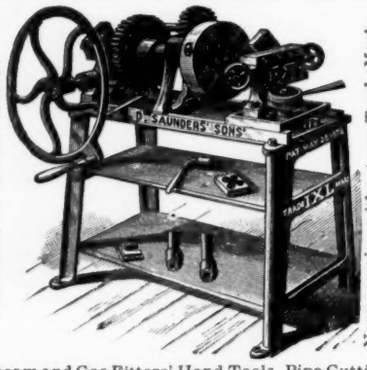
Shunk Plow Company, at Bucyrus, Ohio, will build a new and modern blacksmith shop and equip it with the very best modern machinery. Besides new forges of great capacity and additional steam hammers it will also be supplied with rolls and dies, so that much of the steel work now forged out will be done by a single turn or stroke of the machine. The need of such machinery and the additional room has long been recognized, but it has now become an absolute necessity. The plans also contemplate an extension of the machine shops, but this part of the improvement may have to go over for another year.

At a recent meeting of the Hazleton (Pa.) Flax Mill Co. it was decided to rebuild the factory as soon as the insurance money is paid. Secretary Leisenring said: "We will put up three buildings, one manufacturing, a warehouse and an office. The warehouse will not contain a window, and will be built of stone, brick and iron. In this will be stocked the flax, hemp, etc., and as we need it we will load it on trucks and run it into the factory. Not a pound of it will be left in the factory at the close of a day's work. The new plant will be much larger than the old one, and over 100 hands will be given employment. Once the contract is let we expect to have the mill in running order in sixty days."

D. SAUNDERS' SONS,

Manufacturers of the Original
TRADE I. X. L. MARK.
Pipe Cutting and Threading Machine.

BEWARE OF IMITATIONS.



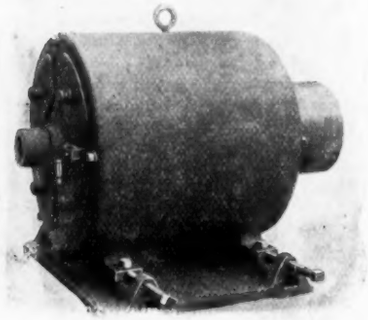
None genuine without our Trade Mark and Name.

Steam and Gas Fitters' Hand Tools. Pipe Cutting and Threading Machines for Pipe Mill use a specialty.
SEND FOR CIRCULAR.
21 Atherton St., YONKERS, N. Y.

The Worcester Polytechnic Institute.

WORCESTER, MASS.
T. C. MENDENHALL, President.

Courses of study in Mechanical, Civil and Electrical Engineering, Chemistry and General Science. New and extensive laboratories in Engineering, Electricity, Physics and Chemistry. Special facilities in Steam and Hydraulics. 194 page Catalogue, showing positions filled by graduates, mailed free. Address J. K. MARSHALL, Registrar.



The C & C Slow Speed Closed Ironclad Motor

is especially designed for hard service in mills and factories. Can be placed in any position and belted, direct connected or back geared to its work.

Highly Efficient and Non-Sparking.

Comp.ete Electric Power Transmission Systems.

The C & C Electric Co.,
143 Liberty, Street, NEW YORK.

R. POOLE & SON CO.
ENGINEERS, FOUNDERS AND MACHINISTS,
BALTIMORE, MD.
MANUFACTURERS AND DESIGNERS OF ALL KINDS OF
HEAVY MACHINERY,
REQUIRING FIRST CLASS WORKMANSHIP AND MATERIALS.
BAND, ROPE AND FLY WHEELS, FRICTION CLUTCHES, PULLEYS, SHAFTING AND HANGERS,
MACHINE MOLDED AND PLANED GEARING.
POOLE-LEFFEL TURBINE WATER-WHEELS.
CIRCULARS ON APPLICATION.

CARBORUNDUM:

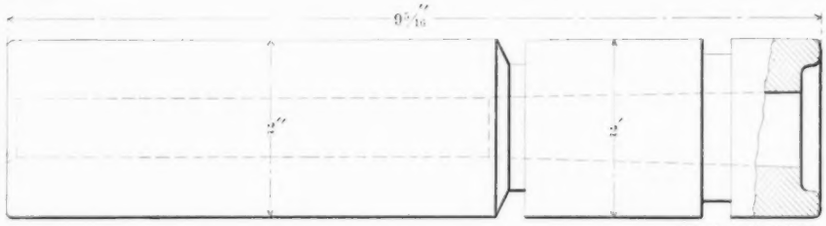
THE CARBORUNDUM CO. · NIAGARA FALLS, N.Y.

The Most Durable and Efficient Grinding Material on the Market.

Carbide of Silicon. Si C

Wheels, Hones, Rubstones, Cloth and Paper.
Grains and Powders for Polishing, Valve Grinding, etc.
It replaces Ferro-Silicon in the manufacture of steel.
Send for Illustrated Catalogue and Price List.

Good Grinding Machinery,



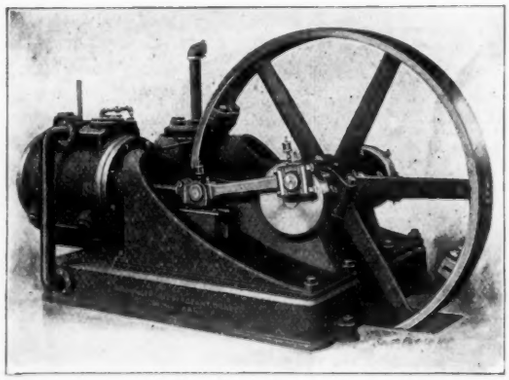
American Machinist

Soft steel spindle finished 10 minutes .005" stock removed

like that made by the Landis Tool Co., must be constructed rigidly enough to resist vibrations. Landis Grinders are practically one casting—cannot vibrate. That's one reason why Landis Grinders handle work with such pleasing results as to accuracy and rapidity. You would find it a hard job to handle a little piece like the above on a lathe in twice or three times the time shown, and as for accuracy, that would be out of the question on a lathe in the usual way of doing such work. The chances are that you'll find some very interesting data in the catalogue—free to those interested enough to write for it.

Landis Tool Co., Waynesboro, Pa., U. S. A.

Hill, Clarke & Co., Boston and Chicago.
C. W. Burton, Griffiths & Co., London.
Ad. Janssens, Paris.
Schuchardt & Schutte, Berlin and Vienna.
Walter H. Foster, Manager, New York.



CUT THIS OUT and send to us with name and address and get Booklet **137**
Shows 12 types of

Air Compressors.

Name and address here :

THE **Ingersoll-Sergeant Drill Co.,**
Havemeyer Building, New York.

Air Compressors, Rock Drills, Channelers. The Pohlé Air Lift Pump.

Champion Tool Steel.

ATHA AIR-HARDENING.
DENMAN & DAVIS, . . NEW YORK AGENTS,
85 and 87 John Street.
THE BENJAMIN ATHA & ILLINGWORTH CO.

Index to Advertisers.

	PAGE
Acme Machinery Company	16
Acme Malleable Iron Works	46
Adams Co.	6
Albro-Clem Elevator Co.	14
Almond, T. R.	2
American Gas Furnace Co.	2
American Tool & Mach. Co.	11
American Tool Works Co.	45
Armstrong Bros. Tool Co.	46
Armstrong Mfg. Co.	46
Atha & Illingsworth Co., Benj.	6
Backus Water Motor Co.	41
Baird & Co., Henry Cary	3
Baird Machinery Co., U.	13
Baker Brothers	4
Baldwin, Davidson & Wight	41
Ball Bearing Co.	16
Barnes Co., W. F. & John	44
Barr & Co., H. G.	14
Beaman & Smith	14
Becker Mfg. Co., John	7
Bement, Miles & Co.	41
Bentel & Margedant Co., The	3
Berlin Iron Bridge Co.	47
Besly & Co., Chas. H.	48
Bethlehem Foundry & Machine Co.	2
Bethlehem Iron Co.	43
Bickford Drill & Tool Co.	47
Bignall & Keeler Mfg. Co.	46
Bilgram, Hugo	44
Billings & Spencer Co.	12
Bliss Co., E. W.	2
Boston Gear Works	41
Bradford Belting Co.	14
Bradford Mill Co., The	15
Bradley Co., The	40
Bristol Co.	48
Brown & Co., R. H.	3
Brown & Sharpe Mfg. Co.	48
Buckeye Engine Co.	47
Buffalo Forge Co.	48
Builders' Iron Foundry	2
Bullard Machine Tool Co.	5
Bullock Electric & Mfg. Co.	10
Burr Mfg. Co.	47
Burt Mfg. Co.	39
Carborundum Co., The	2
Card Mfg. Co., S. W.	5
Case Mfg. Co.	43
C & C Electric Co.	42
Chandler & Taylor Co.	46
Cincinnati Milling Machine Co.	42
Cleveland Machine Screw Co.	4
Cleveland Twist Drill Co.	48
Coffin & Leighton	4
Compress Wheel Co.	4
Cook Co., Asa S.	4
Crescent Steel Co.	8
Crosby Steam Gage & Valve Company	12
Curtis & Co. Mfg. Co.	6
Curtis & Curtis	4
Cushman Chuck Co.	3
Dallet & Co., Thomas H.	44
Detrick & Harvey Machine Co.	47
Diamond Machine Co.	5
Dixon Crucible Co., Joseph	2 and 44
Doan & Co., J. B.	13
Draper Machine Tool Co.	6
Dreses, Mueller & Co.	7
Dwight Slate Machine Co.	12
Eames Co., G. T.	6
Errington, F. A.	3
Evans Friction Cone Co.	11
Fay & Scott	14
Fellows Gear Shaper Co.	8
Fifield Tool Co.	48
Foos Gas Engine Co.	46
Forbes & Co., W. D.	46
Fricke Co., The	46
Gang & Co., Wm. E.	47
Garvin Machine Co., The	15
General Electric Co.	7
Geometric Drill Co.	3
Gisholt Machine Co.	8
Gleason Tool Co.	16
Goddard Machine Co.	6
Goodyear, S. W.	4
Gould & Eberhardt	16
Grant Gear Works	16
Gray Co., G. A.	16
Hampden Corundum Wheel Co.	3
Harrington & King Perforating Co.	48
Hart Mfg. Co.	41
Hartford Steam Boiler Insp. & Ins. Co.	39
Henderer's Sons, A. L.	12
Hendey Machine Co.	38
Hoggson & Pettis Mfg. Co.	3
Horton & Son Co., E.	3
Hurlbut-Rogers Machine Co.	3
Hyatt Roller Bearing Co.	2
Ingersoll-Sergeant Drill Co.	12
Ingersoll Milling Machine Co.	44
International Correspondence Schools	8
Jenkins Bros.	40
Jessop & Sons, Wm.	44
Jones & Co., B. M.	2
Jones & Lamson Machine Co.	1 and 16
Kelley Machine Co., R. A.	44
Kempsmith Machine Tool Co.	43
Keuffel & Esser Co.	8
Keystone Electric Co.	11
Landis Tool Co.	7
Le Blond, R. K.	48
Le Count, Wm. G.	3
Lodge & Shipley Machine Tool Co.	39
Long & Alstatter Co.	6
Mackey Co., Ltd., The	14
Main Belting Co.	47
Mass. Charitable Mechanic Association	44
McCabe, J. J.	13
Mergenthaler & Co., Ott	8
Merrell Mfg. Co.	4
Mianus Electric Co.	46
Mietz & Weiss	46
Monarch Mfg. Co.	46
Moore Cycle Fittings Co.	13
Morse Twist Drill & Machine Co.	15
Morse, Williams & Co.	41
Morton Mfg. Co.	41
Mossberg & Granville Mfg. Co.	14
New Doty Mfg. Co.	3
New Era Iron Works	40
New Haven Mfg. Co.	40
New Process Raw Hide Co.	6
Newton Machine Tool Works, Inc.	8
Nicholson File Co.	8
Niles Tool Works Co.	16
Niles Tool Works Co., New York Branch	13
Norton Emery Wheel Co.	39
Oesterlein, W.	16
Oster Mfg. Co.	43
Page's Sons, Isaiah	46
Pearson Machine Co.	48
Penberthy Injector Co.	11
Pierce Engine Co.	46
Pond Machine Co., L. W.	45
Pope Tube Co.	5
Powell Planer Co.	44
Pratt Chuck Co.	3
Pratt & Whitney Co.	40
Prentiss Tool & Supply Co.	13
Purdue University	41
Q & C Co.	39
Rand Drill Co.	46
Reed Co., F. E.	41
Reeves Pulley Co.	44
Rogers Boat, Gage & Drill Works, John	10
Rue Mfg. Co.	46
Safety Emery Wheel Co.	4
Saunders' Sons, D.	12
Sawyer Tool Co.	8
Sebastian Lathe Co.	40
Sellers & Co., Inc., Wm.	16
Seneca Falls Mfg. Co.	44
Shriver & Co., T.	41
Shultz Belting Co.	16
Sibley & Ware	4
Skinner Chuck Co.	3
Slocomb & Co., J. T.	8
Smith & Mills	12
Spencer Auto. Mach. Screw Co.	11
Springfield Gas Engine Co., The	46
Springfield Machine Tool Co.	42
Standard Machine Co.	11
Standard Tool Co.	48
Starrett Co., L. S.	44
Steel Ball Co.	43
Stevens Arms & Tool Co., J.	43
Stiles Press Co., E. S.	4
Stover Novelty Works	14
Stuart's Foundry & Machine Works, R. J.	48
Tabor Mfg. Co.	46
Tight Joint Co.	3
Timolat, J. G.	40
Toledo Machine & Tool Co.	3
Toomey, Frank	13
Trump Bros. Machine Co.	3
Turner, Vaughn & Taylor Co.	4
T. & B. Tool Co.	16
United States Projectile Co.	13
U. S. Metallic Packing Co.	8
Wais & Roos Punch & Shear Co.	47
Walcott & Sons, Geo. D.	8
Warner & Swasey	48
Washburn, Reginald	16
Wassidlo & Co.	14
Watkins Co., F. M.	46
Watson-Stillman Co., The	12
Weber Gas & Gasolene Engine Co.	46
Webster Mfg. Co.	46
Webster & Perks Tool Co.	43
Wells Bros. & Co.	11
Westinghouse Electric & Mfg. Co.	10
Whitcomb Mfg. Co.	13
Whitney, Baxter D.	6
Whiton Machine Co., D. E.	3
Wiley & Sons, John	40
Wiley & Russell Mfg. Co.	40
Winkley, F. D.	4
Woodward & Rogers	4
Worcester Machine Screw Co.	4
Wyke & Co., J.	41
Wyman & Gordon	48
York, S. M.	13
Young Mfg. Co., W. C.	12

Contents.

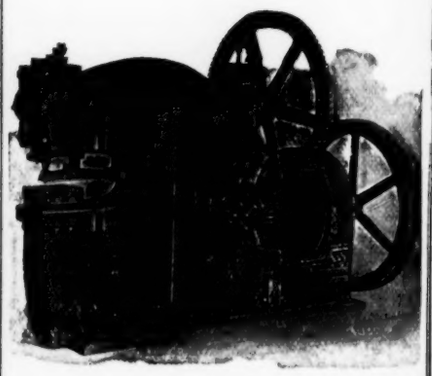
	PAGE
Rolls for Bending Heavy Plate	17
On Comparative Tests. By W. H. Booth	17
The Sims-Dudley Powder Pneumatic Gun	18
Wiener's Method of Graphic Integration. By Leicester Allen	20
A Substitute for Coal as Motive Power. By L. Rudel	22
British Foundries and Foundrymen	22
Gun Making Facilities	23
A Locking Cam That Will Hold	23
The Oldest Steam Engine	23
Deficient Foreign Postage Again	23
The Fan as a Substitute for the Chimney	24
Letters from Practical Men: Some Points About the English Hand Lathe. By R. I. Clegg....Cooking and Mathematics. By Tecumseh Swift....Machinists Have Not Deteriorated. By Quirk....Drill Sockets for Taper Shank Drills. By Charles W. Wright....Loose Pulleys and Friction Clutches. By Bell Crank....Improving the Screw Driver. By Machinist. ....Our Soldiers' Guns. By H. W. K....Loss of Air in Air Chambers of Pumps. By E. M. Chace	25-30
Small Gas Engine Cylinders. By Herbert L. Towle	30
Prospects for Trade in Cuba	31
Technical Publications	31
Inherited Talent	32
The Armament of the American Navy	32
Employment at Springfield Armory	33
Questions and Answers	33
American Association for the Advancement of Science	34
Obituary	34
Personal	34
Inquiries for Machinery	34
Commercial Review	34

50 cents
Machine Shop Arithmetic.

American Machinist,

256 Broadway, New York.

The Bullock Electric Mfg. Co.



BULLOCK MOTOR DRIVING PUNCH.

CINCINNATI, O.

FIXED CALIPER GAUGES.

Manufactured after the

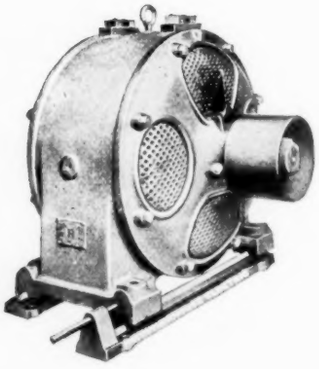
RICHARDS SYSTEM.

Our 1898 Tool Catalogue will tell you all about it.

THE JOHN M. ROGERS,
Boat, Gauge and Drills Works.
GLOUCESTER CITY, N. J., U. S. A.

Tesla Polyphase Induction Motors, Type "C."

The Only Motors Supplying Niagara Power in Buffalo.



Ideal Simplicity of Construction and Operation.

The name of WESTINGHOUSE is a guarantee.

Westinghouse Electric

& Mfg. Co., Pittsburg, Pa.

New York, Boston, Chicago, Philadelphia, St. Louis, San Francisco, Buffalo, Syracuse, Atlanta, Tacoma, Austin. Mountain Electric Co., Denver. For Canada, Ahearn & Soper, Ottawa. For Mexico, G. & O. Braniff & Co., City of Mexico. Westinghouse Electric Co., Ltd., 32 Victoria St., London.

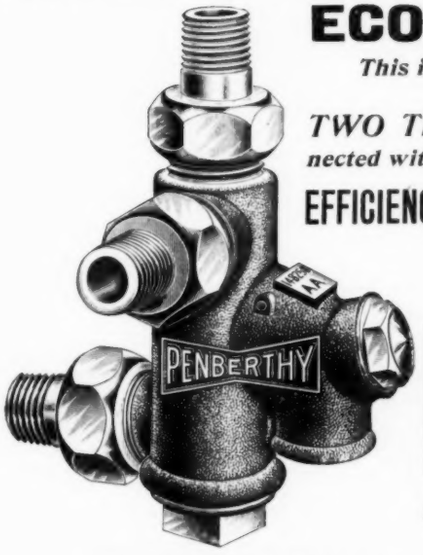
When it comes to Grinding Machinery,

any kind, we can offer you a line of machines that is peerless. The line comprises just about every kind of a Grinding Machine that you could possibly wish for, and they are all good tools, carefully made by good workmen from selected material. We shall be pleased to send the "Green Grinder Book" free.

The Standard Machine Co., Holyoke, Mass., U. S. A.

Selig, Sonnenthal & Co., London. E. Sonnenthal, Jr., Berlin.

CHEAPNESS OF FIRST COST DOES NOT ALWAYS MEAN ECONOMY IN OPERATION.



This is especially true of Boiler Feeding Appliances.

TWO TESTS by Experts in no way connected with our factory show an

EFFICIENCY of 99 22/100 and 99 ½ per cent.

FOR THE

WORLD RENOWNED

TRADE PENBERTHY MARK.

Automatic Injector.

Do You Want Anything More Perfect?

PENBERTHY INJECTOR CO.,

115-131 Seventh Street, DETROIT, MICH.

LARGEST INJECTOR MANUFACTURERS IN THE WORLD.

We've made Machine Tools for 53 years.

They have always been the kind that came into your shop ready for a good, hard day's work.

They have always been the kind that could be depended upon—yesterday, to-day, to-morrow, and all the time.

They never went into a shop needing "a little filing," or with funny fits that needed doctoring. No putty and paint work to cover blemishes. They were just exactly right, or they didn't get outdoors.

The material entering into their make-up has ever been as carefully selected and tested as though it was armor plate, and the workmanship demanded has been equally as exacting.

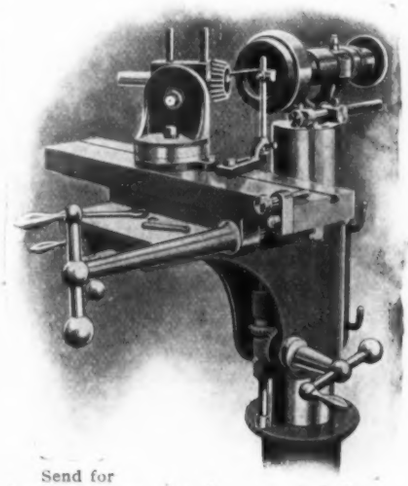
Among other tools which we make we might mention Cabinet Turret Lathes, The Roper Centrifugal Oil Separator, Improved Worrall Friction Clutch, Brass Finishers' Lathes, Shafting, Pulleys, Hangers, etc., particulars of which we shall be pleased to send.

American Tool & Mach. Co., 109 Beach St., Boston, Mass.

Founded 1845. Incorporated 1864.

Fixture and Rest for Grinding Angular Cutters.

Wheel runs TOWARD THE CUTTING EDGE of CUTTER.



Send for Descriptive Catalogue.

Universal Grinding Machine.

WELLS BROS. & CO., Greenfield, Mass.

EVANS FRICTION CONE PULLEYS

Hanging and Standing CONES.

MADE IN ALL SIZES.

Thousands in use transmitting from 1 to 40 H. P. For information address G. F. Evans, Proprietor.

No. 85 Water Street Boston, Mass.

W. BURTON, GRIFFITHS & CO., Agents, London, Eng.

ELECTRICITY

is the most economical and convenient power for Machine Tools.

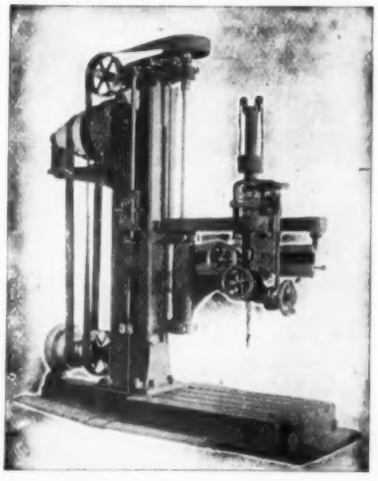
The Best Motor made is

THE "KEYSTONE."

Can be Direct Connected, Belted or Geared.

Adapted to all kinds of machinery.

CUT SHOWS IT APPLIED TO A RADIAL DRILL.



KEYSTONE ELECTRIC CO.,

Erie, Pa., U. S. A.

NEW YORK. BOSTON. CHICAGO.

SPENCER AUTOMATIC MACHINE SCREW CO.

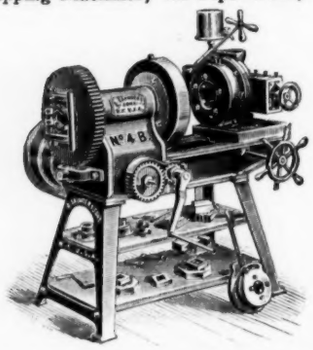
Now Located 111 SHELDON STREET, HARTFORD, CONN., U. S. A.

D. SAUNDERS' SONS,

MANUFACTURERS OF

Pipe Cutting and Threading Machines

Steam and Gas Fitters' Hand Tools,
Tapping Machinery for Pipe Work, Etc.



The No. 4 B Machine for Cutting and Threading Pipe ⅛ to 4 in., by HAND or POWER.

Send for Catalogue to

21 Atherton Street, YONKERS, N. Y.

SHAPERS

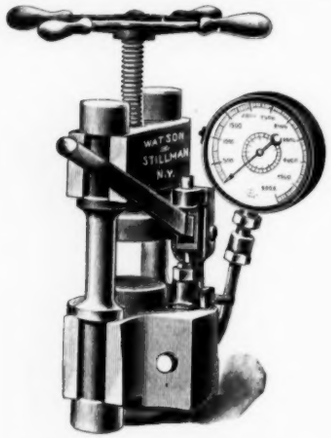
12 to 32 in. Stroke

Manufactured Exclusively.

SMITH & MILLS,

CINCINNATI, OHIO,

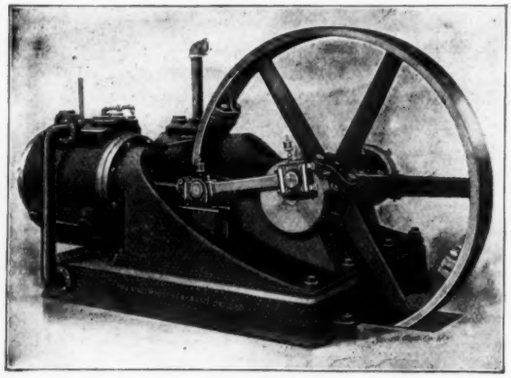
U. S. A.



Laboratory Press.

This press has a ram 4 in., capable of exerting a pressure of 50 tons with a motion of 3 in.; opening under follower is 4 in.; screw is one inch in diameter.

Watson-Stillman Company,
204 East 43d Street, New York City.
Selig, Sonnenthal & Co., London.



CUT THIS OUT and send to us with name and address and get Booklet

137

Shows 12 types of

Air Compressors.

Name and address here :

.....

.....

.....

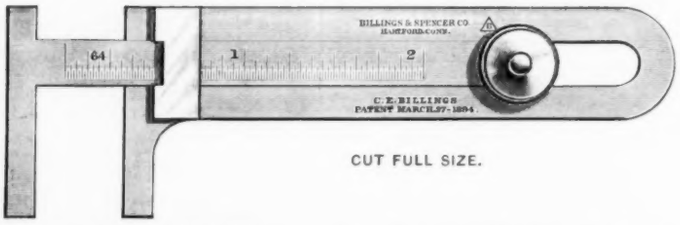
THE Ingersoll-Sergeant Drill Co.,

Havemeyer Building, New York.

Air Compressors, Rock Drills, Channelers. The Pohlé Air Lift Pump.

Billings' 2-in. Pocket Caliper Gauge,

A HIGH GRADE TOOL IN EVERY RESPECT.



CUT FULL SIZE.

THE BILLINGS & SPENCER CO.,

Hartford, Conn., U. S. A.

We Manufacture a Complete Line of

DRILLS

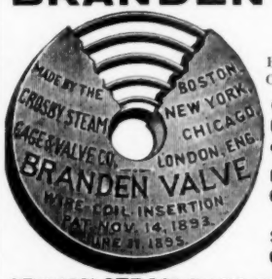
for light work, one or more **Spindles,** hand or automatic feed, of thorough workmanship and strictly up to date. Prompt delivery on regular styles. New Catalogue on application.

DWIGHT SLATE MACHINE CO.,

HARTFORD, CONN.

Chas. Churchill & Co., Ltd., London and Birmingham.
Schuchardt & Schutte, Berlin, Germany.

BRANDEN Pump Valves



Rubber with Wire Coil Insertion.

One Valve will last longer than three of any other make.

POP SAFETY VALVES
CROSBY RECORDING GAGES,
STEAM ENGINE INDICATOR.

CROSBY STEAM GAGE AND VALVE CO.
Main Office and Works, Boston, Mass.
STORES: Boston, New York, Chicago, London.

Henderer Jacks,

of all kinds for all services. Made to be depended upon at all times, without failures of any character. Made from the best of material, and workmanship is of the highest class.

A. L. Henderer's Sons, Wilmington, Del., U. S. A.
85 Maryland Avenue.

LATHES, PUNCHES and SHEARS.

{ GET OUR PRICES. }

W. C. YOUNG MFG. CO.,
Worcester, Mass., U. S. A.

Special Lot

SECOND-HAND TOOLS.

ENGINE LATHES.

14 in. x 6 ft. Blaisdell, R. & F. rest.
14 in. x 6 ft. Flather, taper att.
16 in. x 6 ft. Blaisdell, R. & F. rest.
17 in. x 6 ft. Prentice Bros., plain rest.
18 in. x 8 ft. Flather, latest pattern.
18 in. x 14 ft. Muller, taper att.
20 in. x 12 ft. D. W. Pond, Cpd. rest.
20 in. x 12 ft. Perkins, latest, 1 9-16 hole.
21 in. x 10 ft. Putnam, Cpd. rest.
24 in. x 22 ft. D. W Pond, Cpd. rest, etc.
25 in. x 12 ft. Putnam, Cpd. rest.
26 in. x 14 ft. Perkins, latest pattern.
30 in. x 20 ft. Fifield, blocks to 40 in.
32 in. x 18 ft. Fay & Scott, latest pattern.
40 in. x 14 ft. Fitchburg, Cpd. rest.
90 in. x 30 ft. Ames, triple geared.

PLANERS.

16 in. x 4 ft. Hendey friction.
26 in. x 5 ft. Pond Machine Tool Co.
30 in. x 8 ft. Gleason.
36 in. x 12 ft. Sellers, ext. side head.
48 in. x 16 ft. Putnam Machine Co.
60 in. x 16 ft. Fitchburg, two heads.

SHAPERS.

12 in. stroke Prentiss, crank motion.
15 in. stroke Hendey, latest pattern.
24 in. stroke Hendey friction,

UPRIGHT BORING AND TURNING MILLS.
50 in. and 12 ft. Wm. Sellers & Co.

HORIZONTAL BORING AND DRILLING MACHINE.
Floor machine for large work.

UPRIGHT DRILLS.
Various sizes—Prentice, Blaisdell and Snyder.

RADIAL DRILLS.
52 and 84 in. swing
Universal radial drill, 13 ft swing, full Universal.

UNIVERSAL MILLING MACHINES.
Cincinnati, Brainard and Brown & Sharpe.

SCREW MACHINES.
Wire feed and plain, various sizes.

BOILER ROLLS, PUNCHES AND SHEARS.

J. J. McCABE,
14 DEY ST., NEW YORK.

BARGAINS IN
NEW AND SECOND-HAND MACHINERY.

Lathes, from 12" to 48"; Planers, from 20" up to 60. 48", 54" and 60" Radial Drills; No. 2 Newton Milling Machine; No. 2 Screw Machine; Shapers, from 6" to 30", Boilermakers' Punches, Shears, Edge Planers, Rolls, Drills, Engines, Boilers, Pumps, and Dynamos.

FRANK TOOMEY, 131 N. THIRD ST., PHILA.

U. BAIRD MACHINERY CO.
523-525 Water St.; 524-526 First Ave.,
PITTSBURGH, PA.

MACHINE TOOLS.
SECOND-HAND TOOLS.

One 36 in. x 28 ft. Betts Engine Lathe.
One 24 in. x 10 ft. New Haven Engine Lathe.
One 21 in. x 7 ft. Lodge & Davis Turret Lathe.
One 15 in. x 5 ft. A. T. & M. Co. Fox Lathe.
One 30 in. x 30 x 7 ft. New Haven Planer.
One 26 in. x 26 x 7 ft. New Haven Planer.
One 48 in. A. Box & Co. Radial Drill.
One 36 in. Gould & Eberhardt Spur Gear Cutter.
One 19 in. Putnam Slotter.
One 10 in. New Haven Slotter.
One 48 in. Pulley Borer.

SECOND-HAND GAS ENGINES.

1 16½ H. P. Slide Valve Otto Gas Engine, complete, with fly-wheel and belt pulley..... $275
1 8 H. P. Otto Gas Engine, with iron base, complete, with fly-wheel and belt pulley. 200
1 8 H. P. Otto Gas Engine, without iron base, otherwise complete 175
1 7 H. P. Charter Gas Engine, with base, fly-wheel and pulley..... 200
1 3½ H. P. Gas Engine, Upright, with fly-wheel and pulley..... 125
1 2½ H. P. Olds Gas Engine, Upright, two fly-wheels and pulley..... 185
1 2½ H. P. Otto Gas Engine, Upright, with fly-wheel and pulley..... 140

S. M. YORK, Cleveland, Ohio.

SECOND-HAND MACHINERY.

ENGINE LATHES.

1 11 in. x 4 ft. ann.
1 14 in. x 3 ft. 6 in. Putnam.
1 14 in. x 3 ft. 6 in Prentice.
1 15 in. x 6 ft. Starr.
1 15 in. x 6 ft. W. & L.
1 16 in. x 7 ft. D. & H.
1 18 in. x 8 ft. D. & H.
1 27 in. x 10 ft. D. & H.
1 32 in. x 13 ft. Bement.
1 48 in. x 18 ft. G. & S.
1 48 in. x 16 ft. Fifield.

PLANERS.

2 16 in. x 16 in. x 4 ft. Hendey,
1 24 in. x 24 in. x 6 ft. Powell.
1 28 in. x 28 in. x 8 ft. G. & S.
1 30 in. x 30 in. x 8 ft. S. & S.
1 30 in. x 30 in. x 10 ft. Niles.
1 32 in. x 26 in. x 12 ft. Gray.
1 36 in. x 36 in. x 12 ft. Powell.
1 36 in. x 36 in. x 18 ft. Sellers.
1 54 in. x 54 in. x 20 ft. Niles.

SHAPERS.

1 9 in. traveling head, Wm. Sellers.
1 13 in. Traveling Head, Bement.
1 16 in. G. & E., triple G.
1 16 in. G. & E., single G.

DRILLS.

1 34 in. Harris, Bk. G.
1 32 in. L. & D.
1 3-spindle Hendey.
1 No. 3 4-spindle Garvin.
1 6-spindle Quint.
4 Suspensions, Pond.

SCREW & CHUCKING MACHINES.

1 No. 2 P. & W., plain,
1 No. 1 Costello, wire feed.
1 No. 2 Costello, wire feed.
1 No. 2 1-2 P. & W., wire fd.
1 No. 4 Windsor, plain,
1 No. 4 Windsor, wire feed.
1 No. 2 Niles.
1 18 in. P. & W. Chucking Machine

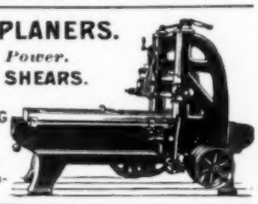
MISCELLANEOUS.

1 P. & W. Grant Pattern Miller.
1 48 in. Niles C. W. Borer.
1 48 in. Industrial C. W. Borer.
1 72 in. Niles B. & T. Mill.
1 3 ft. Riveter, "Portable."
1 No. 2 P. & A. Cyl. Borer.
1 10 in. New Haven Slotter.

Send for New List. Prices on Application.

THE NILES TOOL WORKS CO.,
138 Liberty Street, New York City.

WHITCOMB PLANERS.
Hand and Power.
PUNCHES AND SHEARS.
WHITCOMB MANUFACTURING COMPANY,
Worcester, Mass.
English Agts., Selig, Sonnenthal & Co., London.



SECOND-HAND TOOLS, Practically New.

Cleveland Automatic Screw Machines.
Garvin Bicycle Hub Machinery.
Garvin Bicycle Chain Machinery.
Ferracute Power Presses, dial and roll feed.
Full particulars and prices on application.
Retiring from business.

THE MOORE CYCLE FITTINGS CO.,
Harrison (Newark), N. J., U. S. A.

For Sale.

72 in. x 72 in. x 40 ft. Planer

Made by

POND MACHINE TOOL CO.,
Plainfield, N. J.

Has two heads on cross rail and one side head on each upright; latest pattern; never used; will sell at a bargain. Address

PLANER, care American Machinist.

WANTED.

8 inch Cutting-off Machine and 24 or 26 inch Turret Chucking Lathe.

A Morton No. 2 Keyway Cutter, Old Style.

Address, with lowest price and full particulars,

THE UNITED STATES PROJECTILE CO.,
53d Street and 1st Ave., BROOKLYN, N. Y.

We have rented

an additional warehouse at No. 65 South Canal Street and will place in same a large consignment of both new and second-hand Machine Tools, which will be offered at special prices.

Almost two hundred machines in stock.

Do not fail to write us before purchasing.

J. B. Doan & Co.,
68-70 South Canal Street, Chicago.

A FEW GOOD
SECOND-HAND TOOLS.

LATHES.

86 in. x 21 ft. Wilmarth, triple geared, all att's.
62 in. x 22 ft. Putnam, triple geared, good as new.
36 in. x 12 ft. Putnam, C. R. & P. C. feed.
25 in. x 10 ft. Pratt & Whitney, C. R. & P. C. feed.
3 26 in. Stevens pulley lathes (old style).
21 in. x 10 ft. Fifield, C. R. & P. C. feed, heavy pattern.
20 in. x 11 ft. William Sellers, C. R. & P. C. fd., A1.
19 in. x 8 ft. Lodge & Davis, C. R. & P. C. feed.
17 in. x 8 ft. Putnam, R. & F. rest and P. C. feed.
2 16 in. x 7 ft. Grant & Bogart, R. & F. weight rest.
2 13 in. x 5 ft. Pratt & Whitney stud lathes.
2 12 in. x 5 ft. Prentice Bros., R. & F. rest.
16 in. x 6 ft. Roberts, square arbor Fox.
15 in. x 6 ft. Lodge & Davis, Fox monitor.
15 in. x 5 ft. 6 in. American Tool & Machine Co., square arbor Fox.
Lot of speed lathes, from 10 to 14 in. swing.

DRILLS.

60 in. Hilles & Jones, boiler makers' post.
64 in. Bickford, boiler makers'.
36 in. Sellers, back gears and power feed.
34 in. Bickford, plain.
26 in. Prentice Bros., back gears and power feed.
3-spindle Slates, sensitive drill, with chucks.
2-spindle Norton sensitive, with power feed.
4-spindle Lamson gang, with chucks.
2 3-spindle Garvin gang.

PLANERS.

48 in. x 48 in. x 12 ft. Putnam Machine Co., A1.
42 in. x 42 in. x 16 ft. Bement, all parts, good order.
36 in. x 36 in. x 16 ft. L. W. Pond.
25 in. x 25 in. x 7 ft. Harrington.
24 in. x 24 in. x 8 ft. Pratt & Whitney.
16 in. x 16 in. x 3 ft. 6 in. Walters, with chuck, as good as new.
2 16 in. x 16 in. x 12 in. Whitcomb, with chucks.

SHAPERS.

32 in. Prentiss friction, with all attachments.
24 in. Walcott shifting belt, all attachments.
24 in. Hendey friction, with all attachments.
16 in. Prentiss friction.
16 in. Betts traveling head, crank.
2 15 in. Hendey frictions, with all attachments
15 in. Steptoe crank, with all attachments.

MILLING MACHINES.

No. 2 Grant & Bogert, double column, bk. geared.
No. 2 Brown & Sharpe, plain, back geared.
No. 1 Cincinnati, full universal.
22 in. x 22 in. x 5 ft. Ingersoll slabbing.
4-spindle Warner & Swasey valve, nearly new.
No. 3 Hilles & Jones vertical.
No. 3 Garvin hand, without arm.
No. 1½ Pratt & Whitney hand, without arm.

PRESSES, PUNCHES, SHEARS AND HAMMERS.

P-3 Ferracute power press, 1½ in. stroke.
D-73 Ferracute, drawing press, 6 in. stroke.
5 double housing power presses, very similar to No. 75 Bliss, strokes ranging from 1½ to 6 in., average weight 5,500 lbs.
No. 3 Stiles power press, 2 in. stroke.
2 No. 2 Erdle power presses, 1 in. stroke.
No. 23 Kent punch and shear, 21 in. throat.
1,100 lb. Billings & Spencer friction drop hammer.
800 lb. Merrill friction drop hammer.
600 lb. Pratt & Whitney friction drop hammer.
400 lb. Peck poppet drop hammer.
300 lb. Peck poppet drop hammer.
50 lb. Bradley upright hammer.
15 lb. Bradley helve hammer.

Send for complete lists of new and second-hand machinery in stock.

PRENTISS TOOL & SUPPLY CO.
Machine Tools,
115 Liberty St., NEW YORK.
BRANCHES: Chicago, Cleveland, Buffalo.

RUSSIA.

WOSSIDLO & CO.,

MERCHANTS AND ENGINEERS,
ST. PETERSBURG and... MOSCOW.
Represented in all important towns of Russia.
Contractors to the Imperial Russian Navy, Artillery, Railroad and Mining Department, Etc.
Are open to enter into correspondence with first-class American firms with a view to representing them in Russia, and request price lists of machinery and of all recent technical inventions.

SENSITIVE UPRIGHT DRILLS.

Four Styles. Also Tool Grinders.

H. G. BARR & CO.,

51 Union Street, Worcester, Mass.

Quick Sales. Catalogue B. Small Profits.

We may not

ship $1,000,000 worth of tools a year, but we make and sell a great many more than most people think we do.

People are getting to know that the Engine Lathes, Pattern Makers' Lathes, Turret Lathes, Planers, Centers, etc., made by Fay & Scott are good, honest, reliable tools, and that when it comes to a matter of price—but that's another story.

Fay & Scott,

Dexter, Maine.

Hill, Clarke & Co., Boston.
Prentiss Tool & Supply Co., New York.

AUTOMATIC BICYCLE HUB DRILL.

Adjustable to any angle, spaces holes accurately. Boy can drill 25 hubs an hour and operate two machines. No countershaft needed.

STOVER NOVELTY WORKS. } **Freeport, Ill.**

C. W. BURTON, GRIFFITHS & CO., London, Eng., Agents.

Does your

Detail and Drawing Paper

give perfect satisfaction? If not, send to us for samples and prices of paper that will.

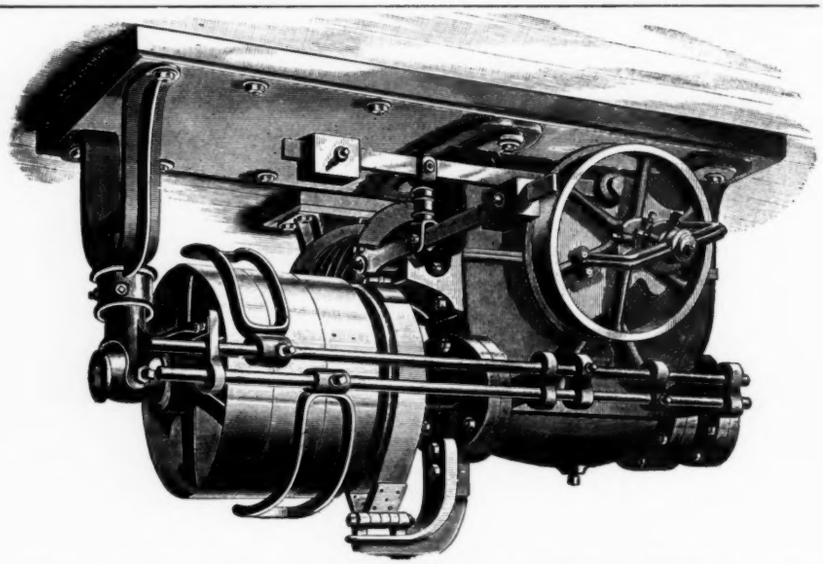
DRAWING ROOM SUPPLIES.

Send for illustrated catalogue.

The Mackey Company, Limited.

Importers and Manufacturers,

PITTSBURG, PA.



This is absolutely the best Freight Elevator Winding Machine made, and you would be surprised to learn how cheaply you can buy it. Ask now. Don't wait.

ALBRO-CLEM ELEVATOR CO.,

Philadelphia, Pa., U. S. A.

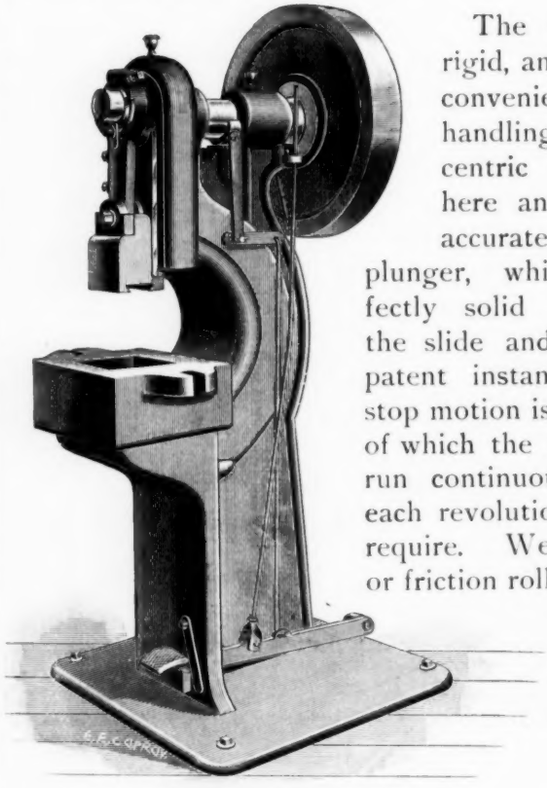
THE BRADFORD BELTING CO.

CINCINNATI, OHIO, U. S. A.

"MONARCH" RIVETLESS LEATHER BELTING.

Write for Catalog "A."

No. 3 Style D Power Press.



The frame is extremely rigid, and will be found very convenient in setting dies and handling material. Our eccentric adjustment is used here and permits rapid and accurate adjustment of the plunger, while forming a perfectly solid connection between the slide and crank shaft. Our patent instantaneous clutch and stop motion is provided, by the use of which the press can be set to run continuously or stopped at each revolution, as the work may require. We furnish ratchet, dial or friction roll feed with this press if desired.

Mossberg & Granville Mfg. Co.

Providence, R. I.

126 Liberty St., New York.
Exhibit at Philadelphia Bourse.

Chas. Churchill & Co., London. Schuchardt & Schutte, Berlin, Vienna, Brussels Mathey Doret, Chaux-de-Fonds, Switzerland.

We Make Boring Machines, Milling Machines, Special Tools BEAMAN & SMITH, PROVIDENCE, R. I.

MORSE TWIST DRILL AND MACHINE CO.,

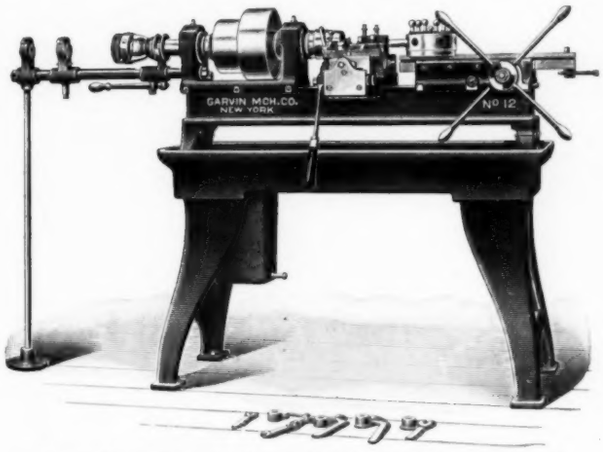
ILLUSTRATED CATALOGUE SENT FREE UPON APPLICATION.

NEW BEDFORD, MASS., U. S. A.

MANUFACTURERS OF

Facts are stubborn things.—SMOLLETT.

Twist Drills, Chucks, Reamers, Milling Cutters, Taps and Dies, and Machinists' Tools.



No. 12 Extra Capacity Screw Machine with Wire Feed and Forming Cross Slide.

Extra Large Capacity

WIRE FEED SCREW MACHINES KEPT IN STOCK.

Large Hole in Spindle.
Two Step Cones.
Extra Wide Belts.

Send for new Catalogue (now in press).

The Garvin Machine Co.,

Spring and Varick Sts., New York.

Berlin Store: The Garvin Machine Co., m. b. H., 17 Burg Strasse, Berlin, C., Germany.
Agents for Great Britain: C. W. Burton, Griffiths & Co., 23a Ludgate Hill, London, E. C., England.
Philadelphia Store: The Garvin Machine Co., 51 North 7th Street.

Engravings

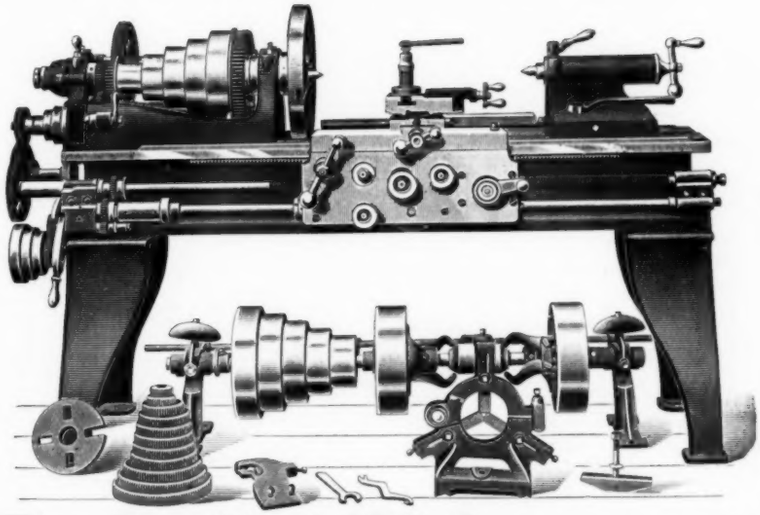
made by the American Machinist possess the peculiar property of showing the article illustrated in a very pleasing manner, and a careful regard for important details make these cuts worth having. You can get cuts cheaper, but none better. This is for people who want good engraving, not the "how cheap" kind.

American Machinist, 256 Broadway, New York City.

"BRADFORD"

Means the Best Engine Lathe Built.

14, 16, 18, 21, 25, 31 and 36 inch.



Beds any length desired.
English or metric screws.
Any form of tailstock.
Patented feed arrangement.

Feeds can be driven with either belt or gearing without disconnecting either. Lathes are furnished complete. Compound rest and improved taper attachment if desired. These Lathes are adapted to handling either light or heavy work and are all carefully tested before leaving our works. Write for Catalogue A to

The Bradford Mill Company, Cincinnati, Ohio, U. S. A.

Lieber's Code used. Cable address: "Stewart, Cincinnati."
Charles Churchill & Co., Ltd., London and Birmingham. Adolphe Janssens, Paris, France. J. A. Fay & Egan Co., Chicago, Ill.
Schuchardt & Schutte, Berlin, Vienna, Brussels, Stockholm. The E. A. Kinsey Co., Cincinnati, Ohio. J. W. Wright & Co., St. Louis, Mo.
Pacific Tool & Supply Co., San Francisco, Cal. Philadelphia Bourse, Philadelphia, Pa.

14-INCH SLOTTER.

MACHINE TOOLS OF ALL TYPES AND SIZES

. . . Patterns for 300 Different Types.

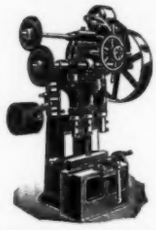
Photographs and Descriptions on Application.

THE NILES TOOL WORKS CO.,

Hamilton, Ohio.

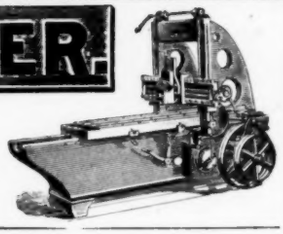
NEW YORK. CHICAGO. PITTSBURGH. PHILADELPHIA. BOSTON. ST. LOUIS.

GREAT BRITAIN: 39 Victoria St., London, S. W.



3-SPINDLE RAIL DRILL.

THE GRAY PLANER.

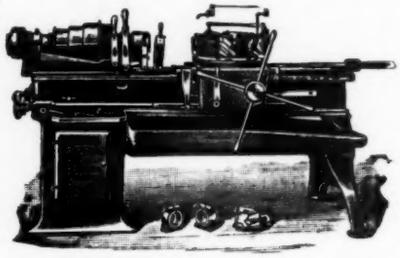


The G. A. Gray Co.,

Cincinnati, Ohio,

Manufacture Planers as an exclusive specialty.

Planers only! Nothing but Planers!!



William Sellers & Co. Incorp.

PHILADELPHIA, PA.

MODERN TOOLS FOR MODERN METHODS.

PULLEYS and SHAFTING. Boring Mills Bending Rolls, Bolt Cutters, Cranes, Lathes, Planers, Slotters, Punches and Shears, Mechanical Stokers, Turn-Tables, Testing Machines, Etc. INJECTORS for ALL SERVICE.

"Constant Angle" Twist Drills,

with holes for lubricant through solid metal.
Made with taper shanks, fitting collets. Illustrated in this space in issue of MACHINIST for July 21.
Adapted for use in ordinary Drill Presses or Boring Machines.

The T. & B. Tool Company, Danbury, Conn., U. S. A.

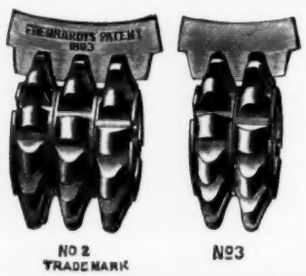
Catalogue on application.

MILLING MACHINES PLAIN AND UNIVERSAL.

W. OESTERLEIN, 307 WEST SECOND STREET, CINCINNATI, OHIO.

EBERHARDT'S PATENT

RADIAL DUPLEX GANG CUTTERS



NO 2 TRADE MARK

№3

2 to 10 Teeth Cut at Once.

Labor, Time, Patience, Money **Saved.**

GOULD & EBERHARDT, Newark, N. J.

Schuchardt & Schutte, general agents, Berlin, Vienna and Brussels; Selig, Sonnenthal & Co., London, England; John Lang & Sons, Johnstone, Scotland; White, Child & Beney, Shaper agents, Vienna, Austria; G. Koeppen & Co., Shaper agents, Moscow" Russia.

GRANT GEARS

GEAR WHEELS AND GEAR CUTTING

of every description.

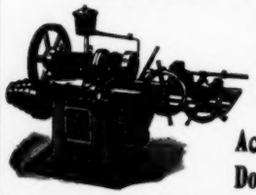
GRANT GEAR WORKS,

626 Race Street, PHILADELPHIA.
6 Portland Street, BOSTON.
86 Seneca Street, CLEVELAND.

Send for Catalog.

The Acme Machinery Co.,

CLEVELAND, O.,



Manufacturers of

Acme Bolt and Rivet Headers.

Acme Single, Double and Triple

Automatic Bolt Cutters. *Cutting from 1-8 in. to 6 in. Diameter.*

Also Separate Heads and Dies.

The Flat Turret Lathe

Does Lathe work accurately up to 2 in. diameter by 24 in. long

Jones & Lamson Machine Co.

Springfield, Vermont, U. S. A.

English Offices: Room 6, Exchange Building, Stephenson's Place, Birmingham, G. H. Pond, Manager; and 26 Pall Mall, Manchester, in charge of Henry Kelley & Co.

Germany, Belgium, Holland, Switzerland and Austria-Hungary. M. Koyemann, Charlottenstrasse, 112, Dusseldorf, Germany.

Dividends come not

when you are wasting your power in friction losses due to poor bearings or bearing metals.

Hub Roller Bearings reduce these losses so low that they almost disappear. Book free.

The Ball Bearing Company,

12 Watson St., Boston, Mass.

EXPORT TRADE A SPECIALTY. ST. LOUIS, MO.

SPURS
BEVELS
CORE WHEELS
PATTERN GEARS
INTERNAL GEARS
MACH. MOULDED GEARS

GLEASON TOOL CO. 6 RACE ST. Rochester N Y

Small Screw Machine Work

OF EVERY KIND.

Bicycle Spoke Nipples.

REGINALD WASHBURN,

WORCESTER, MASS.